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Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region

1998 Annual Report



November 1999



Western Pacific Regional
Fishery Management Council
1164 Bishop Street, Suite 1400
Honolulu, Hawaii 96813

Cover photo: Lehi (*Aphareus rutilans*), Onaga (*Etelis coruscans*),
Opakapaka (*Pristipomoides filamentosus*), Ehu (*Etelis carbunculus*), and
Hogo (*Pontinus macrocephala*). Fresh catch from the Northwest Hawaiian Islands



A report of the Western Pacific Regional Fishery Management Council pursuant to
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Prepared by the Bottomfish Plan Team and Council Staff

for the

Western Pacific Regional Fishery Management Council

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Bottomfish and Seamount Groundfish Fisheries of the Western Pacific

1998 Annual Report

1.0. INTRODUCTION

The 1998 annual report provides a set of descriptors and indicators of the bottomfish fisheries from American Samoa, Guam, Hawaii and the Northern Mariana Islands. The descriptors are designed to document recent trends in landings, effort, participation, revenue and prices. Should management action be recommended, descriptor information will aid in assessing potential impacts of the action on fishery participants. The indicators are quantifiable and measurable tools used to identify signs of stress in the stocks or the fishery. Based on changes over time in indicator levels, the Bottomfish Plan Team (BPT) may identify "yellow light" situations (i.e., where stress is first detected) and recommend that either management action or additional study be undertaken or "red light" situations where immediate management action is needed.

The annual report is organized as follows: The introduction section defines and briefly explains the descriptors and indicators. The next section briefly summarizes time trends in descriptor and indicator levels, through the current year, and recommends any areas of concern for each island area. Reports from each island area are appended. The introduction describes the history and present characteristics of the fishery. Results of the current year's descriptors and indicators are presented in detail, in relation to past temporal trends. Figures are supported with information on source of the data, methods of calculation, and data interpretation. Table 1 summarizes 1998 bottomfish statistics for the region. The appended report from each area includes a summary, which addresses progress made on the previous year's recommendations, and lists new recommendations. Finally, additional appendices contain information on NMFS 1998 administrative and enforcement activities, habitat conditions, protected species interactions, and 1998 BPT membership.

Table 2 lists scientific, common English and local/indigenous names for bottomfish management unit species (BMUS) for each area (American Samoa, Guam/Northern Marianas, and Hawaii).

1.1 Definition of Descriptors

The fishery descriptors are defined as follows:

1.1.1 Landings information

Time series information on aggregate catch for each island area shows recent trends in total bottomfish harvest. For American Samoa and Guam, estimates of both the commercial landings and the total landings (combined commercial, recreational and subsistence) are available. For

Table 1. Regional Summary of 1998 Bottomfish Species

	Hawaii						
	AS	GU	NMI	All	MHI	Mau	Hoomalu
BMUS Landings (lb)	12,926	44,097	45,835	793,528	461,528	66,000	266,000
Revenue (\$)	34,129	42,966*	156,256	2,590,000	1,629,000	182,000	779,000
No. Of Boats	17	367	50	---	480	7	7
No. Of Trips	91	8,765	317	---	2,857	39	50
CPUE	13.6 lb/hr	2.5 lb/hr	145 lb/trip	---	194 lb/trip	1,689 lb/trip	5,315 lb/trip
SPR	0.45	---	---	0.25-0.53	note 1	note 2	note 2

* Guam's revenue based on commercial landing of 13,011 pounds

* Guam's revenue based on commercial landing of 13,011 pounds

Notes:

- 1) Species with Spawning Potential Ratio near or below threshold level of 0.20, indicating localized subarea depletion: MHI onaga ("targeted" SPR = 0.05); MHI ehu ("targeted" SPR = 0.095); MHI hapuupuu ("best/worst" SPR = 0.24)
- 2) Healthy (SPR > 0.20) for all species (Mau Zone=0.54, Hoomalu Zone=0.68)
- 3) Revenue for NWHI zones combined was \$961,000

Table 2. Bottomfish Management Unit Species (BMUS) Names
(Absence of an indigenous name implies no local name established or area is not within the species' geographic range.)

Scientific	English Common	American Samoa	Guam/ CNMI	Hawaii
Bottomfish:				
<i>Aphareus rutilans</i>	red snapper/silvermouth	palu-gutusiiva	maraap tatoong	lehi
<i>Aprion virescens</i>	gray snapper/jobfish	asoama	tosan	uku
<i>Caranx ignobilis</i>	giant trevally/jack	sapoanae	tarakito	white ulua/pau'u
<i>C. lugubris</i>	black trevally/jack	tafauli	trankiton attilong	black ulua
<i>Epinephelus fasciatus</i>	blacktip grouper	fausi	gadao matai	hapu'upuu
<i>E. quernus</i>	sea bass			ehu
<i>Etelis carbunculus</i>	red snapper	palu-malau	guihan boninas	onaga
<i>E. coruscans</i>	red snapper	palu-loa	onaga	
<i>Lethrinus amboinensis</i>	ambon emperor	filoa-gutumumu	mafuti/lililok	
<i>L. rubrioperculatus</i>	redgill emperor	filoa-pa'o'omumu	mafuti tatdong	
<i>Lutjanus kasmira</i>	blue-line snapper	savane	sas/funai	ta'ape
<i>Pristipomoides auricilla</i>	yellowtail snapper	palu-i'usama	guihan boninas	yellowtail kalekale
<i>P. filamentosus</i>	pink snapper	palu-'ena'ena	guihan boninas	opakapaka
<i>P. flavipinnis</i>	yelloweye snapper	palu-sina	guihan boninas	yelloweye opakapaka
<i>P. seiboldi</i>	pink snapper		guihan boninas	kalekale
<i>P. zonatus</i>	snapper	palu-sega	guihan boninas/gindai	gindai
<i>Pseudocaranx dentex</i>	thicklip trevally		terakito	butaguchi/pig ulua
<i>Seriola dumerili</i>	amberjack		guihan tatdong	kahala
<i>Variola louti</i>	lunartail grouper	papa	bueli	
Seamount Groundfish:				
<i>Beryx splendens</i>	alfonsin			kinmedai (Japanese)
<i>Hyperoglyphe japonica</i>	ratfish/butterfish			medai (Jap.)
<i>Pseudopentaceros richardsoni</i>	armorhead			kusakari tsubodai (Jap.)

Hawaii and the Northern Marianas, landings information represents only the commercial harvest.

In Hawaii, changes in species catch composition are provided for the Main Hawaiian Islands (MHI) and the Northwestern Hawaiian Islands (NWHI). Statistical tests for consistency in catch composition over time and between areas are included. Where possible, descriptor information has been presented for each NWHI management zone: Hoomalu and Mau. For 1998, pounds landed by species are presented in tabular form for each area except Hawaii. For Hawaii, NWHI BMUS landings by species are provided for 1986 through 1998.

1.1.2 Effort information

Effort is measured in number of trips for Hawaii and the Northern Marianas, and in both hours fished and trips taken for American Samoa and Guam.

1.1.3 Participation information

Estimates of the number of vessels making bottomfish landings are provided for all areas.

1.1.4 Economic information

Time trends in economic performance are characterized by plots of total ex-vessel revenue, aggregate average price levels, and for Hawaii, price trends over time for major species. In time-series of prices and revenues, it is appropriate to adjust value for the rate of inflation so that values throughout the time period are comparable (based on a consistent purchasing power for the dollar). Both the unadjusted and adjusted aggregate average price and aggregate revenues are plotted to clarify the relative change over time.

1.2 Definition of Indicators

Indicators were developed as tools for identifying signs of stress in the stocks or the fishery which deserve further investigation and/or a management response. Analyses consider how the indicators change over time. Indicators for Hawaii include 95% confidence intervals. To the degree possible, similar variance estimates are expected from the other areas in future annual reports. The indicators are defined as follows:

1.2.1 Aggregate Catch-Per-Unit-Effort

If the current year's aggregate catch-per-unit-effort (CPUE) is less than 50% of the average aggregate CPUE for the first three years of available data, there may be cause for concern. CPUE information is available for all areas; research CPUE is available for SE Hancock Seamount for all years since 1985, except in 1992 and 1994-1998.

1.2.2 Mean Fish Size

If there has been a significant reduction in mean fish size for a species over time, the stock may be stressed by the fishery. Mean size information is provided for nine species in Hawaii. No mean size information was available at this time for American Samoa, Guam or the Northern Marianas.

1.2.3 Percent Immature

If over 50% of the catch for a species is below the size of first maturity, the stock may be stressed by the fishery. Information for this indicator by species is available only from Hawaii.

1.2.4 Spawning Potential Ratio

The spawning potential ratio (SPR) is the ratio of the spawning stock biomass per recruit, at the current level of fishing, to the spawning stock biomass per recruit that would occur in the absence of fishing. According to the overfishing definition contained in the Bottomfish FMP (Amendment 3, 1990), if SPR is less than or equal to 0.20, recruitment overfishing has occurred (i.e., spawners have been reduced to 20%, or less, of their unexploited stock level). Data to calculate SPR were not available from Guam or the Northern Marianas. An estimate of the "worst case" SPR was calculated for American Samoa's bottomfish complex using Dory Project data to estimate the virgin population CPUE and information on percent of immature fish from Hawaii. In Hawaii, SPR was calculated for five major species in the Hoomalu and Mau Zones, of the NWHI, and the MHI; some SPR values changed slightly from previous year's reports due to improvement in the calculations. SPR for armorhead was calculated annually since 1985, except for 1992 and 1994-1998.

1.2.5 Economic Indicators

Revenue per trip plots are presented for all areas except the MHI. A more valuable indicator for the commercial fisheries, which may be available in the future, would be net revenue (ex-vessel revenue minus costs per trip). Net revenue is available only from the Hoomalu Zone and Mau Zone in Hawaii.

2.0 AREA SUMMARIES

2.1 American Samoa

2.1.1 Descriptors

Bottomfish landings, which declined from 1988 to 1992, rose slightly in 1993 and dramatically in 1994. The decline was attributed to the following: the three hurricanes that struck the territory (in 1987, 1990 and 1991), the departure of several highliners from the fishery,

the shift in importance from bottomfishing to trolling, and the substitution of imported fish from Western Samoa and Tonga. The significantly greater 1994 total landings, when compared to the previous years, occurred primarily due to improved catch recording, an increase in effort by highline vessels, and a high fish demand for government and cultural events. The 1998 total landing dropped 51% from the 1997 landings. 1998 total landings were only 25% of the 17-year average and was the smallest catch since 1982. The declining trend in total landings since 1996 is mainly due to the reduction of bottomfish fishing effort by highliners to more profitable longlining methods.

Fishing effort, measured by the number of trips, dropped 54% in 1998. Again, the decrease in effort was due to fishermen seeking other more stable and lucrative lines of work. This is reflected by the drop in total number of boats in 1998 from 26 to 17.

The average price per pound increased in 1998 by 40% to \$3.01. Inflation adjusted values experienced fluctuations no greater than 12% from 1985-1997. 1998's increase is attributed to an increase in demand for fresh bottomfish.

2.1.2 Indicators

CPUE (pounds per hour), though relatively stable (at about 10 lb/hr) in the early 1990's, increased in 1996 to 17.5 lb/hr, mainly due to improved sampling. CPUE declined by about 12% for the second straight year in 1998 to 13.6 lb/hr. This level is not less than 50% of the average aggregate CPUE for the first three years of available data (9.7 lb/hr), indicating no cause for concern. The proxy "worst case" SPR was 0.45 in 1998, indicating that recruitment overfishing has not occurred. Size and maturity data were collected from key species, but insufficient sample sizes were available for a more realistic SPR estimate. Bottomfish revenue per trip (as opposed to total revenue) remained stable in 1998, halting a three-year declining trend.

2.1.3 Recommendations

According to DMWR Chief Biologist, DMWR will begin collecting appropriate data to calculate a more realistic SPR estimate for American Samoa's bottomfish complex in 1999, as recommended by this team for the past two years.

2.2 Guam

2.2.1 Descriptors

The fairly large fluctuations over time in bottomfish landings in Guam appear to be due more to entry and exit patterns of fishermen, rather than changes in fish stocks. The number of highliners fishing in the area doubled from 1993 to 1994, increasing the total commercial BMUS harvest and revenue by nearly 300% during that year. In 1998, the total BMUS landings increased by 50%, primarily rebounding from 1997's poor weather and that few fishermen

concentrated on deep-water bottomfish. The total commercial BMUS harvest increased 39% from 1997, due to several highliners making multiple trips to a remote bank.

The increase in total BMUS from in the past few years is due primarily to an increase in recreational and subsistence-type boats participating in the fishery. The 1995 total number of boat hours and trips increased nearly 175% due to the recreational and subsistence-type boats and the calm seas throughout most of 1995, which allowed many of them to participate in bottomfishing more often than usual. The general increasing trend began in 1986. The slight declines in boat hours and trips in 1996 and 1997 may have been the result of the almost complete absence of highliners participating in the fishery. This year's 23% decline in total landings is likely due to the record low CPUE of 2.5 lb/trip.

The adjusted average price for bottomfish has not shown consistent marketing trends. This is believed to have resulted from the seasonal supply of pelagic fish and difficulties in developing a consistent market for locally caught fish. In addition, imported fish from other islands around the region have contributed to the continued marketing problem for local fishermen. The 1998 inflation-adjusted average bottomfish price of \$3.30 is up slightly from 1997 (\$3.01) but is still low. This may explain why local highliners were almost completely absent from the bottomfish fishery in recent years.

2.2.2 Indicators

In 1998, the CPUE dropped significantly from 1997 to 2.5 lb per hour. Based on an aggregate catch-per-unit-effort average of 6.9 lb/hr for the first three years of data collection on Guam, the 1998 figure has indicated a "yellow light" condition, which may require investigation or a management response. However, it is important to note that CPUE is affected considerably by the predominance of recreational and subsistence-type effort that targets the less productive shallow-water complex of bottomfish.

The adjusted average revenue per trip does not appear to show any long-term trend or cause for concern. The substantial increases in both actual and inflation adjusted revenue per trip occurring in 1994 are best explained by the success of the highliner vessels. The 1995 increase in revenue for all species landed verses the decrease in revenue for bottomfish only, indicated that on average, most commercial fishermen continue to make more money from their trolling efforts than from bottomfishing. The 1996-98 values are representative of the long-term mean.

2.2.3 Recommendations

Status of 1997 recommendations:

Action taken on recommendation 1, to continue working with the WPacFIN program coordinator to develop and implement a customized computer software program that will update, standardize and reprocess Guam's creel survey data, remains ongoing. Included in this effort is

the assignment and training of staff to input and process the DAWR creel survey database from 1980 to the present.

With additional funding from WPacFIN and technical assistance from NMFS, considerable progress was made on recommendation 2, to complete a baseline biological and catch study of the red-gill emperor. The ongoing study consists of three sets of research cruises to compare virgin-stock shallow-water bottomfish catch and biological data collected at Bank A to that of a more heavily fished bank closer to Guam (Galvez Bank and White Tuna Bank). The first set of trips were made in late September and early October, and the second set in mid-October and early November. The third and final set of research trips under the 1998-1999 WPacFIN contract is slated for early May. The results of the research project are expected to be completed by late September, 1999.

The recommendation to establish mean fish size, percent immature and SPR indicators for Guam's shallow-water bottomfish complexes is presently being addressed by the ongoing red-gill emperor project funded by the WpacFIN program. However, technical assistance is still needed to establish the above-mentioned fishery indicators for the deep-water complex.

1998 recommendations:

1) Given the yellow light condition that Guam has gone into based on the CPUE indicator of fishery stress, immediate efforts should be made to confirm and analyze the results of the offshore creel survey expansion in greater detail; especially since the indicator used is an aggregate CPUE and therefore may be more reflective of a localized depletion of shallow-water complex bottomfish in state waters requiring state, rather than federal, management action.

2) Efforts should continue to develop and fine-tune the database computer program that will provide DAWR with the capability of integrating the offshore survey expansion data with the inshore expansion data, and additionally produce statistics of confidence, a compilation of biological data, and a complete species composition analysis according to Plan Team requirements. Upon completion of the computer program, designated DAWR staff should be trained to use the new software to reprocess creel survey data from 1980 to present. Training should also be provided to teach staff how to interface with NMFS/WPacFIN software. Such training would facilitate additional support from NMFS/WPacFIN in the processing and analysis of fisheries data if necessary.

3) The need to complete a baseline biological survey of the red-gill emperor, *Lethrinus rubrioperculatus*, remains as the single most important data deficiency for the Marianas shallow-water bottomfish resource. With the remaining funds provided by the WPacFIN program and technical assistance from NMFS, DAWR should continue with proposed plans to complete the red-gill emperor research project as soon as possible.

4) With additional funding from the WPacFIN program and technical assistance from the NMFS, DAWR should establish mean fish size, percent immature and SPR indicators for Guam's deep- and shallow-water bottomfish complexes.

2.3 Hawaii

2.3.1 Descriptors

Main Hawaiian Islands: Only commercial data are available for both the MHI and NWHI fisheries, even though the MHI recreational/subsistence catch is estimated to be about equal that of commercial landings. In 1988, there was a dramatic increase in MHI bottomfish landings due to a bonanza uku (gray snapper) harvest. A steady decline in total landings occurred until 1993, which was the lowest recorded annual value. Landings in 1994 went up 32% and have remained relatively stable since. 1998 landings are 10% lower than 1997 but are correlated with a 10% decrease in the total number of trips.

Total ex-vessel revenue from the MHI has shown a general decline from 1988-1998 with the inflation adjusted revenue of the MHI fishery being the lowest since 1974, and one-third of 1988's value.

NWHI Mau Zone: Mau Zone 1998 landings have decreased 37% from 1997 and is only 40% of 1995's total landings. The total number of boats decreased from 9 to 7, while the number of trips decreased by 26%. However, bottomfish landings per trip have been stable since 1994.

NWHI Hoomalu Zone: Hoomalu Zone 1998 landings increased 37% from 1996. Seven boats fished in 1998, one more than in 1997, while the number of trips decreased by 2%. Bottomfish landings per trip decreased by 16% based on NMFS CPUE.

Available revenue data are not separated by zone. Overall NWHI inflation adjusted revenue had been relatively stable since 1990 but was down 24% in 1998, the lowest revenue since 1983. This was in part caused by a decrease in the inflation adjusted average bottomfish price, down 19% from 1997, and the lowest average price since 1990.

2.3.2 Indicators

Hawaii Archipelago-wide:

Archipelago-wide SPR estimates are the best method available to assess the Hawaii bottomfish resources and should be the only values used to evaluate overfishing. Evidence from larval drift simulation and preliminary genetic work point to single archipelago-wide stocks with substantial larval transfer between zones (generally from the more healthy northwestern zones toward the more depleted MHI zone).

SPR values for the five major BMUS species in 1998 are all above the 20% critical threshold level, that defines recruitment overfishing under the FMP, when viewed on an archipelago-wide basis. Of these species, onaga is usually the lowest with the 1998 value at only 24%. Implementation of the state's management plan should help improve the condition of onaga in the MHI and increase the archipelago-wide SPR.

SPR values are also presented on a management zone basis (MHI, Mau Zone, Hoomalu Zone) for the purpose of determining locally depleted resources.

MHI: CPUE in 1998 rebounded from its lowest level on record to 194 lb/trip, an 18% increase from 1997. Recent CPUE values are approximately one-fourth the early (baseline 1948-50) values, signifying local depletion in the MHI. The decline is most apparent in ehu, with a recent CPUE of only about 10% that of the initial years of the fishery. The increase in the late 1980's MHI CPUE was primarily due to a large increase in uku catches, and may not indicate an increase in abundance in other species. Most of the more commercially important species in the MHI have had relatively stable mean weights since 1984. Hapuupuu's mean weight dropped sharply in 1993 and has continued to be low. While sample size is low, size of hapuupuu may have declined in the MHI.

For the sixth year 95% confidence intervals were constructed based on "best" and "worst" case bounds of SPR components (CPUE and percent immature). For the fourth year SPR values were calculated using both aggregate CPUE, as in previous years, and targeted CPUE, which gives a more accurate picture for individual species. 1998 aggregate CPUE SPR values for all five major species are marked improvements over critically low levels: onaga (0.08), opakapaka (0.18), uku (0.26), hapuupuu (0.24), and ehu (0.27). The use of targeted CPUE showed a different picture for the four species where targeted trips are available. Here, onaga and ehu SPRs are much worse than indicated using aggregate CPUE (SPR = 0.05 and 0.10, respectively), whereas SPR values for opakapaka and uku are much higher than previously indicated (SPR = 0.31 and 0.33, respectively). Onaga's SPR has now been below 0.20 for 7 of the past 8 years and ehu for all of the last 8 years (using targeted CPUE). Hapuupuu remains on the border of 20% for the fourth straight year.

NWHI Mau Zone: The NMFS CPUE data are only available for the NWHI fishery as a whole since 1984 and by zone since 1988. The NWHI (combined Mau and Hoomalu Zones) NMFS CPUE steadily decreased from 1987 to 1992, rose in 1993, and then declined from 1994-96. CPUE rose in 1997 to the 1993-94 level, but dropped slightly in 1998 to 484 lb/day. The Mau Zone NMFS CPUE had been steadily decreasing since 1989, but increased in 1993 and 1994. In 1997, NMFS CPUE rose 49%. In 1998, the CPUE dropped again to just below the 10-year average at 364 lb/day. The Mau Zone HDAR CPUE decreased 24% in 1998 to 2518 lb/trip, only 50% its 50-year average. Non-parametric 95% confidence intervals were calculated for HDAR CPUEs by the "bootstrapping" method. Mean weights of fish in the Mau Zone continue to exhibit year to year fluctuations, but are generally at much higher values than MHI mean weights. The percent of immature fish in the 1998 Mau Zone catch was still safely under 50% for all species evaluated, except onaga, which rose above 50% for the first time island-wide.

SPR values in the Mau Zone have been decreasing since 1990 (mirroring the pattern in the HDAR CPUE), experienced a surprising rise in 1994, returned to lower levels in 1995, followed by increase from 1996-98. All values are presently above 0.58, well above the critical level of 0.20. SPR values are higher in the NWHI than the MHI because most of the catch is mature fish. SPR values in both NWHI zones have never fallen below 0.35.

NWHI Hoomalu Zone: The Hoomalu Zone NMFS CPUE has been on a downward trend from since data collection began in 1988. 1998 CPUE is at the 11-year low at 527 lb/day. The Hoomalu Zone HDAR CPUE followed an increasing trend, but dropped sharply in 1994 for unclear reasons, rose by 20% in 1995 and has since remained stable. The 1998 5,198 lb/trip was 62% of the average of the first three years (8,440 lb/trip, 1948-50). Mean weights of fish in the Hoomalu Zone continued to exhibit year to year fluctuations, but are still at much higher values than MHI mean weights. The percent of immature fish in the 1998 catch was still safely under 50% for all species evaluated, except for onaga, experiencing a yellow light for the second straight year.

The SPR values in the Hoomalu Zone remained stable or increased in 1998, with all species showing values of 0.73 or higher. The low 1997 SPR for onaga was likely an anomaly, rebounding from an SPR value of 0.35 to 0.94.

Seamount Groundfish (Armorhead): No fishing has been allowed on the armorhead stocks of the SE Hancock Seamount since the moratorium began in August, 1986. The 1993 CPUE, calculated from research longline catches, was more than double that of the last assessment (in 1991) and nearly as high as the highest CPUE recorded since surveying began in 1985. No research cruise occurred since 1993, and future research assessment cruises are unlikely.

No SPR values were available in 1998 as no research was undertaken. In 1993, SPR within the EEZ (SE Hancock Seamount) was above 0.02, the highest since 1986, but still far below (10% of) the threshold level for recruitment overfishing of 0.20. About 99% of the known armorhead seamount habitat occurs outside the U.S. EEZ, an area which had 0.06 SPR in 1993. During February and March 1997, an oceanic and larval armorhead survey over the seamounts outside the U.S. EEZ was conducted onboard the R/V Kaiyo Maru by the National Research Institute of Far Seas Fisheries Laboratory in Shimizu, Japan. Armorhead larvae were collected from surface waters around all seamounts except for Koko Seamount.

2.3.3 Recommendations

1) The BPT recommends that the Council amend the FMP to become fully consistent with the State of Hawaii Administrative Rule 13-94 on MHI bottomfish. This would include closure of areas within the federal jurisdiction as specified in the administrative rule.

2) The BPT recommends that the Council encourage and assist the State of Hawaii DLNR in the implementation of a postcard survey of non-commercial bottomfish fishermen as determined

from the State's BF vessel identification permit list. This survey would be used to estimate recreational catch of bottomfish in the MHI.

2.4 Northern Mariana Islands

2.4.1 Descriptors

Data are available only on the commercial fishery. The declining trend in landings and revenues, which occurred from 1988-91, was reversed by a growth trend which began in 1992. In 1998, bottomfish landings remained high at 45,835 lb, and exceeded the 1994 landings by 125%, due primarily to the growth of the local bottomfishing industry, particularly from new ventures operating full time. The 1994 increase was in vessels of all sizes, including large (50 ft plus) vessels. In 1998, the number of vessels fishing dropped from 68 to 50. The number of trips decreased 15% in 1998, which included regularly scheduled long trips to the Northern Islands, where bottomfish are more abundant.

The average adjusted price per pound received for bottomfish has been stable the past 4 years, at \$3.41 in 1998. The total 1998 ex-vessel revenue remained high at \$156,256. The 3-year sustained high levels of landings and revenue are attributed to expanded bottomfish operations.

2.4.2 Indicators

The average bottomfish catch per trip continued its 7-year increasing trend to 145 lb/trip in 1998. Landings per trip have increased more than threefold since 1991. The average catch per trip is subject to significant biases (e.g., changes in trip length and relative amounts of bottomfishing compared to trolling). It may be possible to improve this measure of CPUE by using only those trips which landed bottomfish species exclusively. While such a calculation may be sensitive to other biases due to small sample size, it should be investigated in the future. This indicator does not suggest the need for any management action.

Revenue obtained from bottomfish sales has remained in step with the increases in landings since 1991. 1998 revenue per trip has also seen a threefold increase since 1991. The average revenue per bottomfish trip in 1998 increased 9% for bottomfish species and 19% for all species, continuing an 8-year trend. All species inflation adjusted revenue, which had been declining from 1988 to 1992, has since made a strong 4-year rise. Per trip revenues have doubled in the past 4 years, reaching a 10-year high. Bottomfishermen often troll to and from the bottomfishing site, thus acquiring a mixed catch after spending the day "bottomfishing".

2.4.3 Recommendations

- 1) To request NMFS and the Council to assist DFW in adequately assessing the status of bottomfish stocks in the southern islands of CNMI.

2) Establish baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/Northern Marianas deep-water bottomfish complex (e.g., survey on grouper, snapper) utilizing data collected during Resource Assessment Investigation of the Marianas Archipelago (RAIOMA) cruises (1981-1984), the current fishing in the Northern Islands and sampling aboard DFW research vessel to help calculate SPR, with assistance from NMFS. (Same as last year)

3) Establish baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/Northern Marianas shallow-water bottomfish complex (e.g. red-gilled emperor) by sampling program aboard DFW research vessel to help calculate SPR, with assistance from NMFS. (Same as last year)

4) With assistance from NMFS/WPacFIN, software should be developed and implemented to separate fishery statistics for the main islands fishery and from the Northern Islands fishery with separate descriptions and statistics reported in the annual report module. (Same as last year)

2.5 Region-Wide Recommendations

1) Concur with the need to continue the recent progress, made through NMFS assistance, to establish baseline parameters for virgin shallow- and deep-water stocks in the NMI.

2) For NMFS to develop methodology for the collection and analysis of appropriate data (for biological stock parameters) and assist the island areas, while acknowledging the recent progress made in Guam.

3) Expand the BMUS list to include generic level designations to include all species (to the lowest taxa reported) of the following major families of shallow-water bottomfish: Lethrinids, Lutjanids, Carangids and Serranids.

4) Concur with the island-area specific recommendations in the annual report (as detailed in the above summary).

Appendix 1

American Samoa

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Summary

During 1998, a total of 17 local boats landed an estimated 13,000 pounds of bottomfish in the territory. Revenues for the domestic commercial fishery this year was estimated around \$34,000, with all the catch being sold locally.

The fishery was relatively bigger between 1982 and 1986 than in recent years (Fig. 1). This observation reflects a trend in the loss of skilled and full-time commercial fishermen from the fishery, depletion of newly discovered banks (mainly the 2% Bank), the shift of preference from bottomfishing to trolling and, recently, the diversion of effort by the commercial bottomfish fishermen to do longlining. The December 1991 hurricane contributed to the 1992 decrease in landings (Fig. 1) and the second lowest number of trips ever recorded (Fig. 3). Compared to the 1982-1986 period, the past three years' landings, effort and subsequently revenues were notably less. This is mainly due to the highliners diverting their efforts towards the more profitable longlining method.

The CPUE in 1998 (13.6 lb/hr) was NOT less than 50% of the aggregate CPUE for the first 3 years of available data and shouldn't cause concern for this fishery. Additionally, the proxy "estimate of the worst case" SPR of 0.45 (refer to the analysis in Fig. 7) indicated that recruitment overfishing is not occurring in this fishery. Even though participation, catch and effort have dropped during this period, indicators derived from current data do not indicate any serious problems with American Samoa's bottomfish fisheries. In fact, this years decline in landings and effort is mainly due to the significant drop in the number of boats participating in this fishery and the increase in interest and participation of the domestic fishermen in the relatively newer fishing method - horizontal longlining.

The following annual statistics, dating back to 1982, provide a brief history of American Samoa's bottomfish fishery.

Historical Annual Statistics					
Years	Total Landings (lb) all Bottomfish	CPUE (Lb/trip.hr)	Inflation adjusted Revenues(\$)	Bottomfish \$/Lb	Number of Boats
1982	64,942	8.5	173,359	2.90	27
1983	126,327	10.0	407,123	3.38	38
1984	94,104	10.7	247,872	2.78	48
1985	104,675	8.1	208,138	2.11	47
1986	98,361	9.6	206,112	2.19	34
1987	30,640	12.5	63,476	2.18	20
1988	64,530	19.7	131,615	2.21	26
1989	48,137	15.3	71,557	1.99	29
1990	15,445	10.2	27,261	2.03	19
1991	17,917	10.0	33,178	2.12	20
1992	13,715	10.5	29,700	2.26	14
1993	17,098	11.4	31,521	2.03	23
1994	39,533	13.1	84,388	2.24	21
1995	30,503	16.5	58,425	2.03	25
1996	39,501	17.5	74,503	1.99	26
1997	27,538	15.2	56,842	2.19	26
1998	12,926	13.6	34,129	3.01	17
Averages	49758.4	12.49	114071.53	2.33	27.1
St.Deviation	36239.0	3.35	103837.06	0.42	9.7

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Introduction

Bottomfishing from canoes by the natives of the American Samoa islands has been a subsistence traditional practice since the distant past. It was not until the early 1970's that the bottomfish fishery developed into a commercial venture utilizing motorized boats. A government subsidized program, called the Dory Project, was initiated in 1972 to develop the offshore fisheries into a commercial venture, and resulted in an abrupt increase in the fishing fleet and total landings. In 1982, a fisheries development project aimed at exporting high-priced deep-water snappers to the Hawaii fish auction caused another notable increase in both bottomfish landings and revenue. Between 1982 and 1988, the bottomfish fishery comprised as much as 50% of the total commercial catch. Beginning in 1988, the nature of American Samoa's fisheries changed dramatically with a shift in importance from bottomfish fishing towards trolling. In the past five years, the dominant fishing method has been longlining.

During the early 1980's, data were collected from the bottomfish fishery by interviewing only commercial vessels. In the current Offshore Creel Survey on Tutuila that started in October 1985, commercial, subsistence and recreational domestic boats landing catch in five designated areas were interviewed and their catches examined. For two weekdays and one weekend/holiday per week, DMWR data collectors sampled offshore fishermen between 0500 and 2100 hours. Two DMWR samplers based on Tau and Ofu collect fisheries data from the Manu'a Islands fleet.

Boat-based fishing in American Samoa used to be just trolling and/or bottomfishing. In the past four years, record longline landings (mainly by the Alia commercial fishermen) were recorded with revenues approaching the one million dollar mark for the first time, this year. The bottomfish fishery of American Samoa is typically commercial overnight jigging using skipjack as bait, on 28-32 foot aluminum Alias. Bottomfish imported mainly from the neighboring independent state of Western Samoa has assisted in satisfying the high demand for fresh fish that cannot be supplied by the small local commercial fleet. The adverse effects of three hurricanes that struck American Samoa in 1987, 1990 and 1991 can be seen in some of the trends in the fishery as depicted by the data in this report.

Recommendations

According to DMWR Chief Biologist, DMWR will begin collecting appropriate data to calculate a more realistic SPR estimate for American Samoa's bottomfish complex in 1999, as recommended by this Team in the past two years.

Table 1. American Samoa 1998 Estimated Total Bottomfish Landings

Species	Pounds
Longnose Emperor	97
Emperors(misc)	863
Golden Bream	60
Tomato Grouper	43
Lunartail Grouper	718
Blacktip Grouper	49
Flagtail Grouper	10
Groupers(misc)	330
Bluelined Snapper	662
Kusakar's Snapper	82
Stone's Snapper	172
Onespot Snapper	27
Yelloweye Opakapaka(<i>P fl</i>)	52
Gindai	284
Gray Jobfish	393
Onaga	3,519
Ehu	1,552
Rufous Snapper	3
Yellow Opakapaka(<i>P filam</i>)	374
Humpback Snapper	580
Yellowtail Snapper(<i>P aurici</i>)	27
Multidens Snapper	19
Hawaiian opakapaka	66
Lehi	281
Oilfish	468
Bottomhandline Snapper	212
Bottomfish (assorted)	590
Amberjack	72
Black Jack	208
Bigeye trevally	11
Jacks (misc)	1,100
Total Bottomfish	12,926
Total BMUS	11,355

Interpretation: Changes in species composition of the bottomfish complex reported in the past are due to samplers' varying ability and commitment to the identification of the various bottomfish species. Current data and observations however, do not indicate any major changes in the composition of the bottomfish landed.

Source: DMWR Offshore Creel Survey database

Calculation: Catches are weighed by species either at landing sites or during the selling of fish to dealers. Data on landings sold to stores are accounted for in a separate Data Collection System - the Invoice Purchase System. The above analysis is from the Offshore Creel Survey data only. Analyses of American Samoa's bottomfish data are for the whole complex, and not just for BMUS.

Table 2. American Samoa 1998 Estimated Average Price of Bottomfish Species

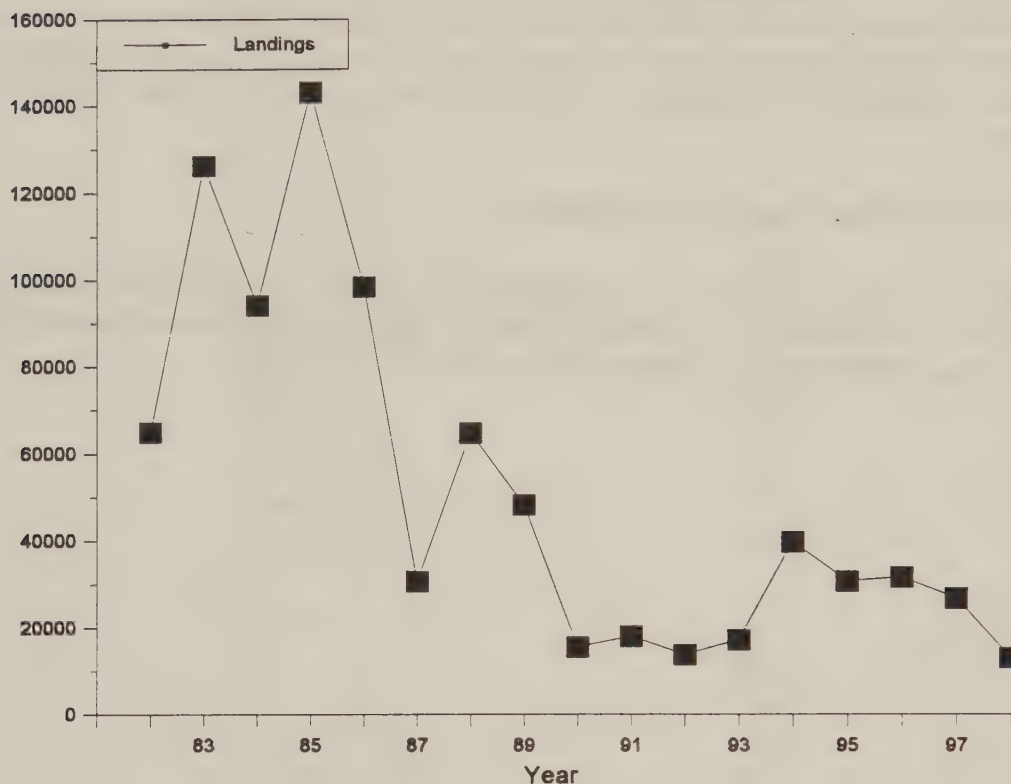
Species	Ave. Price (\$/lb)
Longnose Emperor	2.00
Emperors (misc)	2.00
Tomato Grouper	2.50
Lunartail Grouper	2.03
Flagtail Grouper	2.00
Blacktip Grouper	2.00
Groupers (misc)	2.02
Blueline Snapper	2.04
Kusakar's Snapper	2.00
Stone's Snapper	2.00
Yellowtail Snapper	2.50
Onespot Snapper	2.00
Multidens Snapper	2.00
Yellow Opakapaka(<i>P. filam</i>)	2.00
Gindai	2.40
Gray Jobfish	2.00
Onaga	4.69
Ehu	3.20
Yelloweye Opakapaka	2.00
Humpback Snapper	2.21
Hawaiian Opakapaka	2.00
Lehi	3.12
Bottomhandline Snappers	2.03
Bottomfish (assorted)	2.00
Amberjack	2.00
Black Jack	1.83
Jacks (misc)	2.04
Oilfish	0.50
Total Bottomfish	3.01
Total BMUS	3.11

Interpretation: There appears to be no major changes in the prices of individual species in the past six years. DMWR keeps track of imported bottomfish through a separate Commercial Invoice System. Data from that system reveals that since 1992, the average price of bottomfish imported from Western Samoa were lower than for locally-caught bottomfish. Locally-caught bottomfish are of much superior quality, so local fishermen welcomes the price increase in the past two years.

Source: DMWR Offshore Creel Survey database

Calculation: During creel surveys, the disposition of the catch is recorded, and if sold, the price is obtained whenever possible. The average prices reported in this table are calculated by dividing the total revenue by the weight sold in pounds for each species.

Figure 1. American Samoa bottomfish landings in pounds



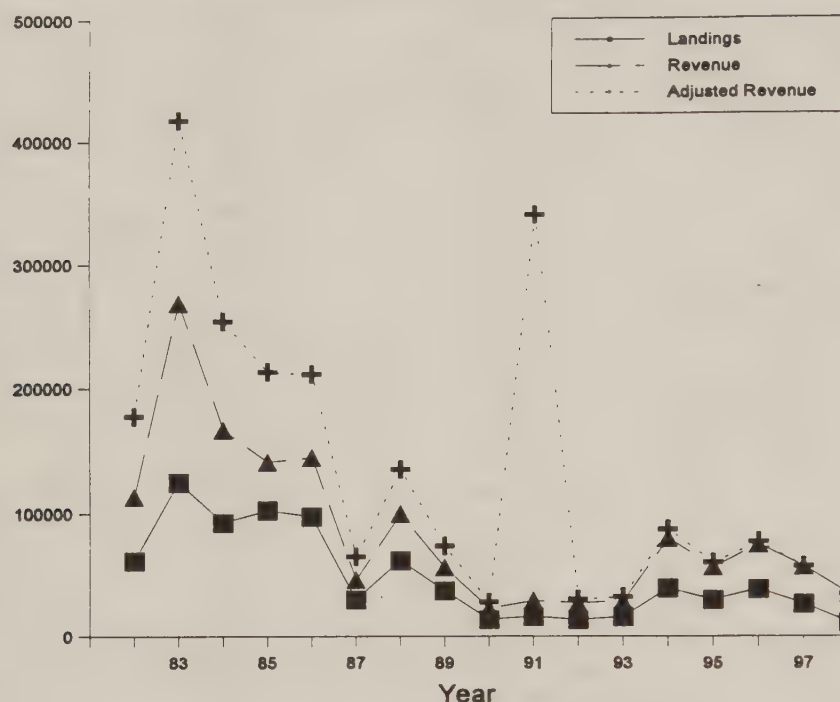
Interpretation: The substantial declines in landings in 1987 and 1990 were partially due to vessel losses caused by two hurricanes. Boat repairs were delayed as fishermen repaired or rebuilt their houses. In terms of total landings, the bottomfish fishery is much smaller in recent years than it was any time between 1982 and 1986, a period when there was a relatively large fleet and fishermen were attracted to the then profitable bottomfish export program. The increase in 1994 was due primarily to improved sampling on Tutuila and increased efforts by the Tutuila highliners. Furthermore, the Manua landings more than tripled due to social/cultural events during that year. Last year, with no additional boats participating and a decrease in bottomfish effort, total landings dropped. This year's total landings dropped 51% compared to last year's as local fishermen concentrated on longlining.

Source: DMWR Offshore Creel Survey database

Calculation: Bottomfish landings for 1982-84 are calculated by adjusting the sampled Tutuila data by the calculated annual percent coverage of the fleet, and then adding the similarly adjusted Manu'a landings. The 1986-present landings are from the creel survey expanded species composition files (*SPC) which contain the annual estimated total landings by species for Tutuila, and then adding the adjusted Manu'a landings. Calculating statistics for 1985 is more complicated because the sampling program changed from commercial fleet sampling only to creel sampling on October 1, 1985.

Year	Landings (lb)
1982	64,942
1983	126,327
1984	94,104
1985	143,225
1986	98,361
1987	30,640
1988	64,530
1989	48,137
1990	15,445
1991	17,917
1992	13,715
1993	17,917
1994	39,533
1995	30,503
1996	31,383
1997	26,499
1998	12,926
Average	51,536
Standard Deviation	41,007

Figure 2. American Samoa annual estimated commercial bottomfish landings.



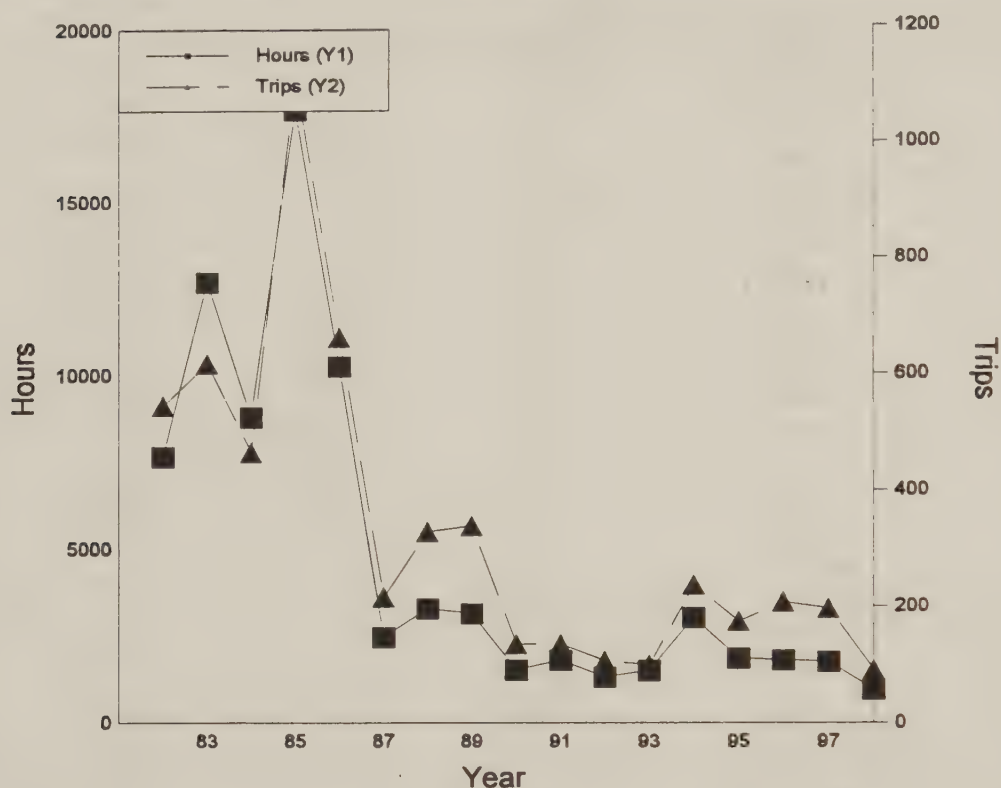
Interpretation: Commercial landings mirror the total fishery's declining catches in recent years. Relative to total landings, commercial landings decreased even more substantially in 1989, because the percent of the catch sold by bottomfish fishermen dropped from an average of about 97% in 1982-88 to 78% in 1989. The peak in 1983 portrays the high prices of deep-water snappers exported to Hawaii, while the trough in 1987 can be attributed to effects of the 1987 hurricane. The December 1991 hurricane contributed largely to the decreased landings and subsequently a decrease in revenues in 1992. Unfavorable weather continued through May 1992 hindering commercial bottomfish trips. Increased efforts in 1994 produced a notable increase in revenues and no major changes in commercial landings have been recorded since then. Declining commercial landings since 1996 mirrors total bottomfish landings for the whole fishery. This trend reflects the shift of participation (and importance) from trolling to longlining since 1995 and doesn't necessarily portray problems with the stocks.

Source: DMWR Offshore Creel Survey database

Calculation: A relatively complex set of algorithms are used to estimate the commercial landings from estimates of total landings created by the creel survey data expansion system. In short, the percent sold by fishing method is calculated monthly and multiplied by the percent species composition by month, then multiplied by the estimated total landings for that method and month. For 1982-85 sampling was conducted on the commercial fleet only (which included nearly all the fishing boats), whereas since 1985 creel sampling has covered all boats (commercial and recreational). Analysis of creel data for 1986-87 indicates that over 98% of the landed bottomfish were being sold. Therefore, it is believed to be valid to compare commercial data for years prior to 1986 to creel survey totals for years since 1986.

Year	Commercial Landings	Revenues	Inflation- Adjusted Revenues
1982	62,016	113,678	180,066
1983	125,167	269,083	422,729
1984	92,841	166,917	257,386
1985	102,670	141,495	216,062
1986	97,540	144,742	214,073
1987	30,236	46,537	65,942
1988	61,897	99,482	136,689
1989	37,438	56,433	74,322
1990	13,992	23,161	28,303
1991	16,296	29,439	34,473
1992	13,663	27,450	30,853
1993	16,146	29,160	32,746
1994	39,126	79,536	87,649
1995	30,010	56,340	60,735
1996	30,843	59,320	61,634
1997	25,374	54,703	55,415
1998	11,374	34,219	34,219
Average	47,449	84,217	117,253
Standard Deviation	36,337	65,681	108,439

Figure 3. American Samoa annual estimated bottomfish hours and trips



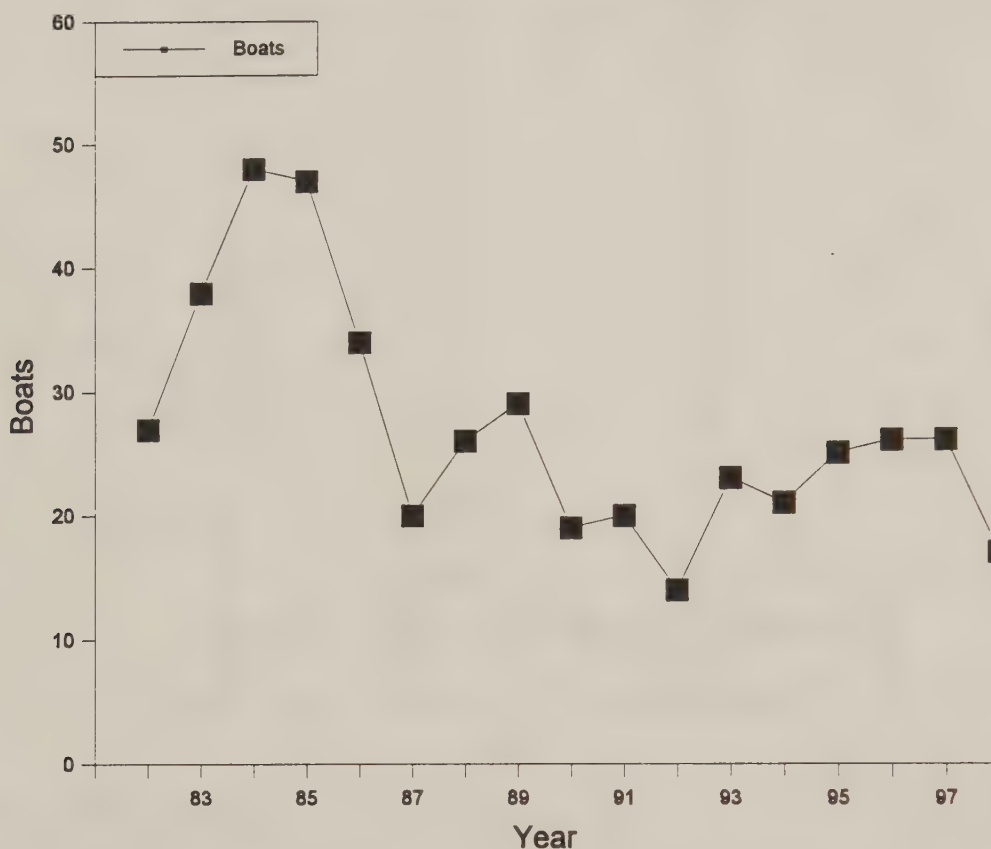
Interpretation: The sharp decline in the bottomfish landings since 1986, noted in Fig. 1 is mirrored in this figure by a sharp decline in the level of effort expended in that fishery. Rather than indicating a problem with the resource, this decline depicts an actual trend of commercial boat owners and fishermen seeking other more lucrative and stable lines of work. The noticeable increase in effort last year is primarily due to improved sampling, increased effort by the Tutuila highliners and the significant (about tripled) increase in effort by the Manua fleet. The bottomfish highliners diverted part of the effort to do longlining efforts in 1994 and contributed to the decrease in bottomfish trips and effort. The 1994-1996 estimated efforts were greater than those for the 1990-93 period due to the highliners increased efforts, with some boat owners employing teams (usually 2-3 fishermen) in continuous shifts during good weather. In 1997 and 1998, the number of boats participating in this fishery dropped significantly (refer to Figure 4) resulting in the notable declines in number of trips and hours fished this year.

Source: DMWR Offshore Creel Survey database

Calculation: The annual estimated effort (hours) spent bottomfish fishing is calculated by dividing the annual estimated total bottomfish catch by the average CPUE (pounds per hour) from trips doing only bottomfish fishing. The annual estimated number of trips is calculated by dividing the estimated annual hours by the average length of a bottomfish fishing trip. The average length of a bottomfish fishing trip (not shown) is calculated by using only trips which exclusively bottomfished and for which the trip length was recorded. The total hours fished from those trips is then divided by the number of trips. Recorded hours are trip hours.

Year	Hours	Trips
1982	7,671	548
1983	12,695	621
1984	8,796	468
1985	17,682	1,116
1986	10,255	666
1987	2,458	217
1988	3,281	330
1989	3,141	340
1990	1,514	136
1991	1,797	136
1992	1,312	107
1993	1,494	100
1994	3,017	238
1995	1,848	175
1996	1,798	208
1997	1,741	197
1998	950	91
Average	4,791	335
Standard Deviation	4,878	273

Figure 4. American Samoa annual estimated number of boats landing bottomfish



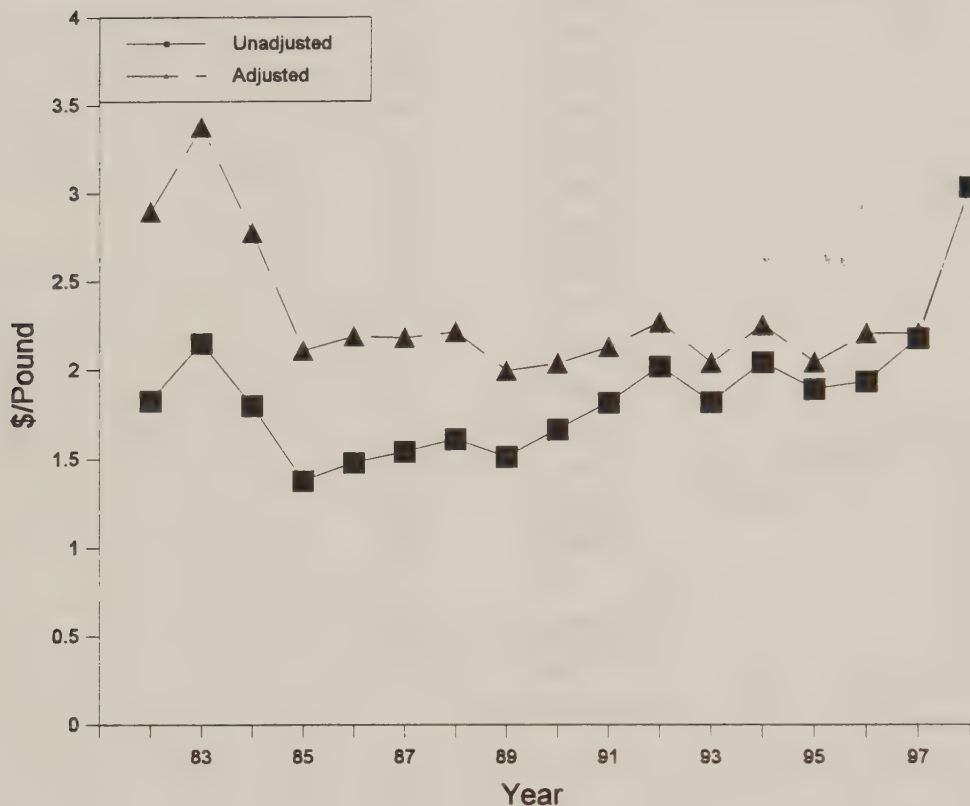
Interpretation: Again, the decline in the fishery since 1985-86 is noted by a decline in the number of boats participating in it. The 1987 hurricane caused the loss of the whole Manu'a fleet, plus some of the Tutuila fleet. Several boats which contributed to the 1989 bottomfish annual landings did not land any bottomfish in 1990, due to much needed repairs and their participation in non-bottomfish chartered trips. About 90% of the domestic fishing fleet was affected by the December 1991 hurricane, hence the decline in 1992. The increase in 1993 is due mainly to the re-entry to the fishery of a few vessels after repairs, trips by two 14-foot vessels that did not bottomfish in 1992, and the entry of one new alia into the sampling area. A few new Alias were bought from Western Samoa and entered the fishery in the 1995 and 1996. The continued increase in the number of boats electing to longline, attracted by the relatively higher revenues obtained mainly from albacore sold to the canneries, is reflected in the significant drop in the number of boats landing bottomfish this year.

Source: DMWR Offshore Creel Survey database

Calculation: The annual estimate of the number of boats in the bottomfish fishery is obtained from the data base by counting the unique boats sampled during the year which landed any bottomfish species.

Year	Boats
1982	27
1983	38
1984	48
1985	47
1986	34
1987	20
1988	26
1989	29
1990	19
1991	20
1992	14
1993	23
1994	21
1995	25
1996	26
1997	26
1998	17
Average	27
Standard Deviation	10

Figure 5. American Samoa average price of bottomfish



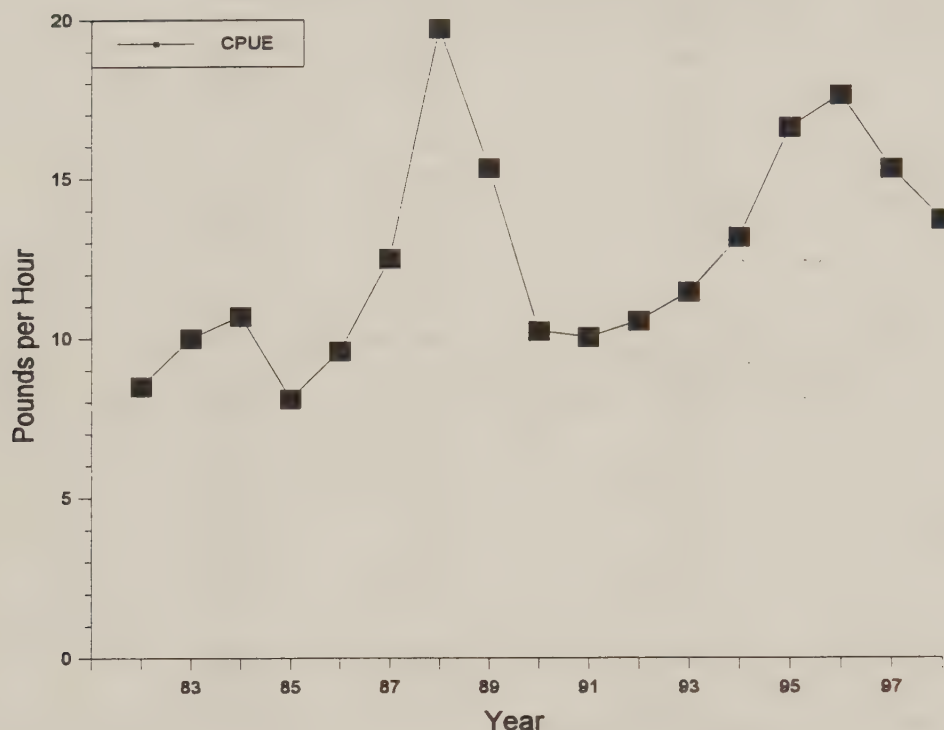
Interpretation: Prices were generally higher between 1982 and 1984 during the exportation of high-priced deepwater snappers to Hawaii. After this period, inflation-adjusted local prices have generally been stable. Prices of locally-caught bottomfish are generally higher than imported fish, and could have been even higher had the local markets not been flooded by imported fish, which are generally of lower quality. The only imported bottomfish in 1994 were from Western Samoa and these were sold at an average price of \$1.67/lb. Imported bottomfish (mainly from Western Samoa) have always helped in meeting the demand for bottomfish. The increase in average price per pound in 1998 is attributed mainly to the increase in demand for fresh bottomfish.

Source: DMWR Offshore Creel Survey database

Calculation: The average price of all bottomfish species combined is calculated by dividing total bottomfish revenue by total sold weight. The inflation adjusted price is calculated by multiplying the unadjusted annual average price by the annually calculated consumer price index (CPI) for American Samoa using the current year as the base.

Year	\$/lb	Inflation- Adjusted \$/lb
1982	1.83	2.90
1983	2.15	3.38
1984	1.80	2.78
1985	1.38	2.11
1986	1.48	2.19
1987	1.54	2.18
1988	1.61	2.21
1989	1.51	1.99
1990	1.66	2.03
1991	1.81	2.12
1992	2.01	2.26
1993	1.81	2.03
1994	2.03	2.24
1995	1.88	2.03
1996	1.92	1.99
1997	2.16	2.19
1998	3.01	3.01
Average	1.86	2.33
Standard Deviation	0.38	0.42

Figure 6. American Samoa annual bottomfish CPUE



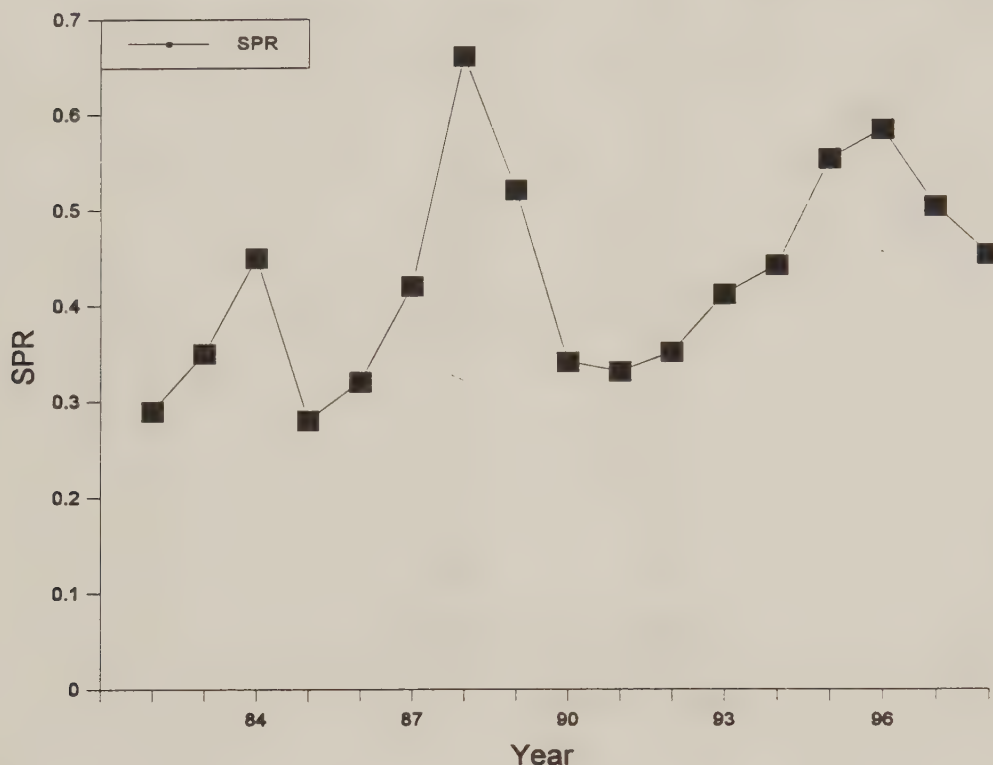
Interpretation: The initial high CPUE in 1983 and 1984 occurred during the intense fishing of some new fishing grounds for deepwater snappers for export to the more lucrative Hawaii auction. A relatively high number of boats and local commercial fishermen participated in the fishery during this period. The drop in 1985 and 1986 might be expected following the ardent harvesting of the limited fishing grounds. Reasons for the CPUE peak in 1988-89 are unknown. The decline in CPUE from 1989 to 1991 can be partially attributed to a combination of some new, inexperienced fishermen entering the fishery and the exit of experienced and full-time commercial fishermen. CPUE has essentially remained stable during 1990 to 1992, and has increased since then. Bottomfishing techniques and gear have generally remained the same in the past years with the Alias being the highliners since the early '70s. The 1995-1996 high CPUE estimates (and most probably the 1988-89 CPUE increase) can be attributed mainly to improved sampling and not necessarily related to the status of the stocks. Last years CPUE of 15.2 lb/trip.hrs was higher than the estimated virgin CPUE of 14.8 and the current year CPUE of 13.6 is NOT less than 50% of the average aggregate CPUE for the first three years of available data (9.7 lbs/hr) indicating no cause for concern.

Source: DMWR Offshore Creel Survey database

Calculation: CPUE (pounds per trip.hours) is calculated using only trips in which only bottomfish method was used and trip hours was recorded. The average is calculated by using each CPUE from each trip as an observation and dividing by the number of trips.

Year	CPUE
1982	8.5
1983	10.0
1984	10.7
1985	8.1
1986	9.6
1987	12.5
1988	19.7
1989	15.3
1990	10.2
1991	10.0
1992	10.5
1993	11.4
1994	13.1
1995	16.5
1996	17.5
1997	15.2
1998	13.6
Average	12.8
Standard Deviation	3.4

Figure 7. American Samoa annual estimated spawning potential ratio for bottomfish complex



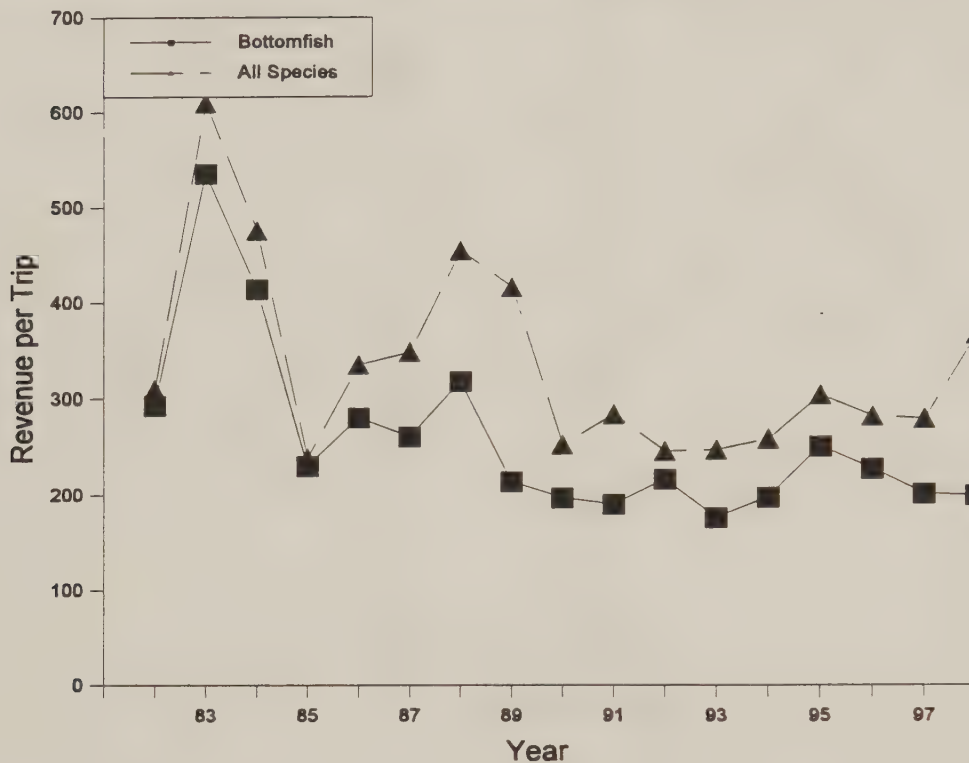
Interpretation: The proxy "worst case" SPR for 1998 was 0.45, substantially above the 0.20 critical level. According to this indicator, the bottomfish complex of American Samoa is not considered to be recruitment overfished. This year's SPR estimate [refer to Calculations below] decreased with this year's decrease in CPUE.

Source: DMWR Offshore Creel Survey database

Calculation: The spawning potential ratio is calculated by dividing the current year's CPUE by the virgin population CPUE, and then multiplying by the ratio of the current percent mature to the virgin population percent mature fish in the catch. To estimate SPR for American Samoa, the "Dory" project mean CPUE (refer to 1990 annual report page 20, Table 3) was used to estimate virgin population CPUE (14.8 lb/hr). Since size and maturity data available for bottomfish in American Samoa are insufficient, the ratio of percent mature in the local catch was estimated by substituting with the average (% mature) of the 5 species which have the lowest SPR in Hawaii (in 1991). In this manner a "worst case" SPR was calculated to provide what should be a very conservative estimate of SPR for the American Samoa bottomfish complex.

Year	SPR
1982	0.29
1983	0.35
1984	0.45
1985	0.28
1986	0.32
1987	0.42
1988	0.66
1989	0.52
1990	0.34
1991	0.33
1992	0.35
1993	0.41
1994	0.44
1995	0.55
1996	0.58
1997	0.50
1998	0.45
Average	0.43
Standard Deviation	0.11

Figure 8. American Samoa average inflation-adjusted revenue per trip landing bottomfish



Interpretation: There have been no notable changes in revenues since 1990. The distance between these two lines reflects the relative importance of bottomfish species in the total catch whenever any bottomfish are landed. The prominent importance of bottomfish between 1982 and 1985 occurred during the targeting of deepwater snappers (mainly *Etelis* and *Pristipomoides*) for export to Hawaii. Bottomfish fishing was also the more profitable method of fishing during that period. The relative importance of bottomfish has generally been declining since 1985 as most of the full-time commercial fishermen quit the fisheries and the remaining opt for trolling. The supply of locally caught bottomfish has been supplemented by bottomfish imported from Western Samoa. A slight decrease in adjusted revenues for bottomfish trips was experienced this year.

Source: DMWR Offshore Creel Survey database

Calculation: The average revenue per trip for all species is calculated by summing the revenue of all sales for any trip which landed any bottomfish species, and dividing by the number of trips. The average bottomfish revenue per trip is calculated from those same trips by summing the sales of only bottomfish species and dividing by the number of trips. Figure 8 plots the inflation adjusted bottomfish and all species revenues per trip for the period 1982-1998.

Year	Bottomfish \$/Trip		All Species \$/Trip	
	Unadjusted	Adjusted	Unadjusted	Adjusted
1982	185	293	196	310
1983	341	536	388	610
1984	269	414	309	476
1985	151	230	157	239
1986	189	280	226	335
1987	184	260	246	348
1988	231	317	331	454
1989	162	213	315	415
1990	161	196	205	251
1991	161	189	240	282
1992	192	215	217	244
1993	155	175	218	245
1994	178	196	233	256
1995	230	248	279	301
1996	217	225	268	279
1997	196	199	273	276
1998	197	197	363	363
Average	200	258	263	334
Standard Deviation	48	93	62	102

Appendix 2

Guam

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Summary

The Guam offshore creel survey expansion system now utilizes a database format, rather than the spreadsheet format used in previous years, to expand the survey data. This improvement, combined with the implementation of offshore creel surveys at the Merizo Pier in 1991 and the Agat Marina in 1994, and recent revisions of expansion algorithms, have contributed to the increased efficiency in the production and reliability of the Guam annual reports. Although complementary statistics of confidence and analysis of biological and species composition data are not possible at this time, DAWR is continuing work with the WPacFIN program coordinator to further develop the expansion system to eventually include production of such analyses. The expansion program will ultimately also have the capability of integrating the offshore survey data with the inshore survey data. Present plans to upgrade computer hardware and software (standardized wordprocessing, spreadsheet and graphics programs), will further serve to facilitate prompt production of required reports.

In October, 1997, staff from the NMFS Honolulu Laboratory, WPacFIN program and DAWR conducted an exploratory fishing research trip to "Bank A" located approximately 117 miles west of Guam. Funded by WPacFIN, the objective of the pilot study was to determine if this rarely fished bank contained a virgin-stock population of the shallow-water complex of bottomfish characterized by an abundance of the red-gill emperor fish, *Lethrinus rubrioperculatus*. The conclusion of the study was that further research of Bank A could serve to address the 1992-1997 recommendations by the Bottomfish Plan Team to complete a baseline biological survey of the *L. rubrioperculatus*.

With additional funding from WPacFIN, plans were thus made to conduct three sets of research cruises in early to mid-1998; the objective being to compare virgin-stock shallow-water bottomfish catch and biological data collected at Bank A to that of a more heavily fished bank closer to Guam (Galvez Bank and White Tuna Bank). However, the vessel contracted for the project sustained extensive damage during Super Typhoon Paka which devastated Guam in December, 1997, and was not available until September, 1998. Consequently, the first set of trips were not made until late-September and early-October, and the second set until mid-October and early-November. The third and final set of research trips under the 1998-1999 WPacFIN contract is slated for early-May. The results of the research project are expected to be completed by the end of September, 1999.

Analysis of the expanded 1998 bottomfish fishery data indicates that Guam's aggregate CPUE per boat trip for all bottomfishing methods, including deep- and shallow-water complexes in both territorial and federal waters, has declined from last year's 4.04 pounds per hour to 2.51 pounds per hour. This CPUE level falls below 50% of the initial average CPUE of 6.91 pounds per hour. Based on this indicator of fishery stress, a "yellow light" condition has been identified which may require further investigation or management response.

Historical Annual Statistics					
Years	Total Landings (lb) all Bottomfish	CPUE (Lb/hr)	Inflation adjusted Revenues(\$)	Bottomfish \$/Lb	Number of Boats
1980	37,399	5.9	41,502	4.42	24
1981	63,654	7.6	55,900	5.34	75
1982	63,442	7.2	36,474	5.51	49
1983	53,404	5.1	181,160	4.99	48
1984	56,998	7.7	102,128	5.08	79
1985	94,318	7.4	126,697	4.68	63
1986	30,368	5.8	50,709	4.42	39
1987	35,033	5.6	53,744	4.25	96
1988	52,791	5.0	64,104	4.06	107
1989	53,272	5.2	91,941	4.73	110
1990	45,374	5.6	83,859	4.56	116
1991	51,329	5.4	46,953	4.36	173
1992	50,099	5.5	41,469	4.01	173
1993	78,355	4.8	38,182	3.77	271
1994	83,367	6.7	116,673	3.86	268
1995	108,741	3.2	46,433	3.48	422
1996	137,790	4.6	17,615	2.68	400
1997	125,801	4.0	28,238	3.01	354
1998	96,648	2.5	42,966	3.30	367
Averages	69,378	5.5	66,671	4.24	170
St.Deviation	30,789	1.4	40,949	0.77	134

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Introduction

Guam has two distinct bottomfish fisheries which can be separated by depth and species. The shallow-water complex (<500 feet) makes up a larger portion of the total bottomfish harvest and is comprised of an assemblage of reef-dwelling snappers, groupers and jacks of the genera *Lutjanus*, *Lethrinus*, *Aprion*, *Epinephelus*, *Variola*, *Cephalopholis* and *Caranx*. The deep-water complex (>500 feet) consists primarily of snappers and groupers of the genera *Pristipomoides*, *Etelis*, *Aphareus*, *Epinephelus*, and *Cephalopholis*.

Bottomfishing on Guam is a combination small-scale commercial and subsistence fishery. This fishery is also highly seasonal in that most bottomfishing effort occurs during the summer months when sea conditions are generally much calmer. The majority of the participants are part-time recreational and subsistence fishermen who operate vessels less than 25 feet in length, primarily target the shallow-water bottomfish complex, combine some trolling effort to supplement bottomfishing effort, and seldom sell their catch commercially.

Historically, notable fluctuations in Guam's annual BMUS harvests have been caused by the respective entry and exit of highliner vessels. These highliner vessels tend to be greater than 25 feet in length and their effort is usually concentrated on the deep-water complex.

Adding to Guam's bottomfishing effort in recent years is the charter fishing component which now includes boats making multiple two to four-hour bottomfishing trips daily. The types of vessels making such trips range from the more typical trolling charter boat involving 3-6 patrons who opt to bottomfish instead, to the larger bottomfishing-only "head-boat" vessels accommodating as many as 30 patrons per trip.

Centrally located on the western leeward coast, the Agana Boat Basin serves as the island's primary small-boat launch site to fishing areas off the central and northern leeward coast, as well as the northern banks. Situated to the south, the Merizo Pier, Umatac Boat Ramp and Agat Marina serve as access points to the southern shores and banks. The Agat Marina in particular, located between the Agana Boat Basin and the Merizo Pier, provides boats trailered from the northern and central portions of the island a closer and more convenient launch site to the southern fishing grounds. Plans to construct two additional boat ramps at presently undeveloped eastern windward launch sites are currently being considered. If completed, the new boat launches are expected to lead to an increase in bottomfishing effort on the eastern side of the island.

The demand for both deep and shallow-water bottomfish continues to exceed the locally-caught supply. Although Guam's deep-water bottomfish fishery has limited economic importance, especially during the absence of highliner vessels, the cultural value of its shallow-water complex remains high due to the popularity of this assemblage of fish as food items. Some of the demand for both complexes of bottomfish is offset with imports from other islands throughout Micronesia.

Recommendations

Status of 1997 recommendations:

Recommendation 1:

Action taken on recommendation 1 to continue working with the WPacFIN program coordinator to develop and implement a customized computer software program that will update, standardize and reprocess Guam's creel survey data remains ongoing. Included in this effort is the assignment and training of staff to input and process the DAWR creel survey database from 1980 to present.

Recommendation 2:

With additional funding from WPacFIN and technical assistance from NMFS, considerable progress was made on recommendation 2 to complete a baseline biological and catch study of the red-gill emperor. The ongoing study consists of three sets of research cruises to compare virgin-stock shallow-water bottomfish catch and biological data collected at Bank A to that of a more heavily fished bank closer to Guam (Galvez Bank and White Tuna Bank). The first set of trips were made in late September and early October, and the second set in mid-October and early November. The third and final set of research trips under the 1998-1999 WPacFIN contract is slated for early May. The results of the research project are expected to be completed by the end of September, 1999.

Recommendation 3:

The recommendation to establish mean fish size, percent immature and SPR indicators for Guam's shallow-water bottomfish complexes is presently being addressed by the ongoing red-gill emperor project funded by the WpacFIN program. However, technical assistance is still needed to establish the above-mentioned fishery indicators for the deep-water complex.

1998 Recommendations:

1) Given the yellow light condition that Guam has gone into based on the CPUE indicator of fishery stress, immediate efforts should be made to confirm and analyze the results of the offshore creel survey expansion in greater detail; especially since the indicator used is an aggregate CPUE and therefore may be more reflective of a localized depletion of shallow-water complex bottomfish in state waters requiring state, rather than federal, management action.

2) Efforts should continue to develop and fine-tune the database computer program that will provide DAWR with the capability of integrating the offshore survey expansion data with the inshore expansion data, and additionally produce statistics of confidence, a compilation of biological data, and a complete species composition analysis according to Plan Team requirements. Upon completion of the computer program, designated DAWR staff should be

trained to use the new software to reprocess creel survey data from 1980 to present. Training should also be provided to teach staff how to interface with NMFS/WPacFIN software. Such training would facilitate additional support from NMFS/WPacFIN in the processing and analysis of fisheries data if necessary.

3) The need to complete a baseline biological survey of the red-gill emperor, *Lethrinus rubrioperculatus*, remains as the single most important data deficiency for the Marianas shallow-water bottomfish resource. With the remaining funds provided by the WPacFIN program and technical assistance from NMFS, DAWR should continue with proposed plans to complete the red-gill emperor research project as soon as possible.

4) With additional funding from the WPacFIN program and technical assistance from the NMFS, DAWR should establish mean fish size, percent immature and SPR indicators for Guam's deep- and shallow-water bottomfish complexes.

**Table 1. Guam 1998 expanded creel survey composition
of bottomfish management unit species (BMUS)**

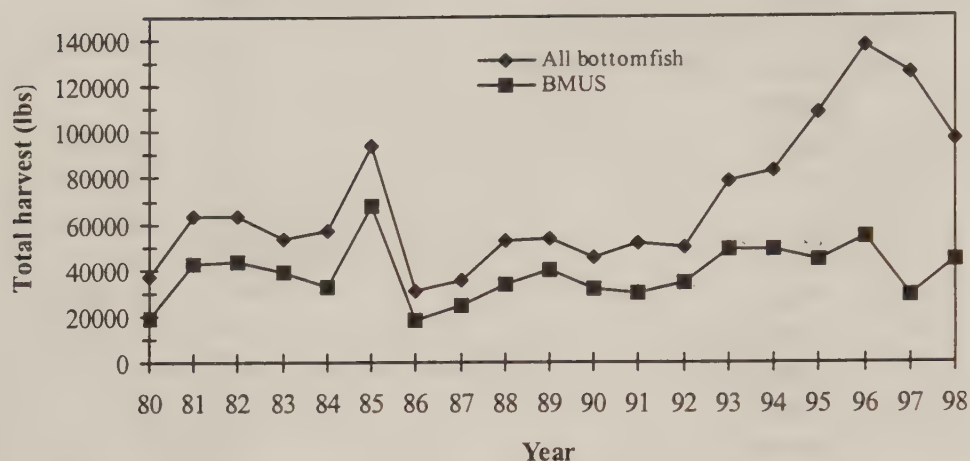
Species	Bottomfishing method only (lbs)
Lehi (<i>A. rutilans</i>)	1,760
Uku (<i>A. virescens</i>)	4,524
Jacks (<i>C. ignobilis</i> , <i>C. lugubris</i>)	2,698
Groupers (<i>C. urodeta</i> , <i>E. fasciatus</i> , <i>V. louti</i>)	9,707
Ehu (<i>E. carbunculus</i>)	855
Onaga (<i>E. coruscans</i>)	0
Emperors (<i>L. amboinensis</i> , <i>L. rubrioperculatus</i>)	4,975
Taape (<i>L. kasmira</i>)	1,827
Kalekale (<i>P. seiboldi</i>)	0
Yellowtail Kalekale (<i>P. auricilla</i>)	2,453
Pink Opakapaka (<i>P. filamentosus</i>)	287
Yelloweye Opakapaka (<i>P. flavipinnis</i>)	2,353
Gindai (<i>P. zonatus</i> , <i>P. argyrogrammicus</i> *)	1,801
Amberjack (<i>S. dumerili</i>)	635
Total	33,875

*non-BMUS species

Table 2. Guam 1998 commercial bottomfish average price

<u>Species</u>	<u>Average \$/lb</u>
Miscellaneous Bottomfish	3.07
Grouper	2.78
Jacks	2.73
Lehi	4.00
Uku	2.83
Ehu	3.93
Onaga	4.74
Opakapaka	3.96
Kalikali	3.51
Gindai	3.79
Emperor	2.94
Amberjack	2.87
All Bottomfish Species	3.30

Figure 1. Guam harvest of BMUS and all bottomfish



Interpretations: Annual fluctuations in BMUS landings on Guam are usually due to highliner fishermen entering or leaving the fishery during a given year. For example, the 1985 peak followed by the apparent crash in 1986 of BMUS harvests were the result of a few highliner fishermen who fished in 1985 and then left the fishery the following year.

Prior to 1993, the “all bottomfish” totals were typically only slightly higher than the BMUS totals and were usually driven by highliner activity. In the last five years however, there have been disproportionate increases in the “all bottomfish” category over that of the BMUS category. Improved data collection and adjustments of expansion algorithms, brought about in large part by the establishment of offshore catch surveys at the Merizo Pier (1991) and Agat Marina (1994) ports, document the fact that the majority of the bottomfishing effort is currently being made by recreational/subsistence and charter fishermen harvesting a higher proportion of non-BMUS fish within territorial waters.

The 9% decrease in the “all bottomfish” category in 1997 may have been caused by the elimination of the bigeye scad, *Selar crumenophthalmus*, as part of the bottomfish catch in the 1997 expansion. The inclusion of this fish in previous bottomfish expansions, especially during a bumper harvest year such as 1996, likely had the effect of inflating bottomfish catch totals. There is also the possibility that the 1997 decline signaled the beginning of a potential crisis for Guam’s shallow-water bottomfish stocks, especially in light of a concomitant decline in CPUE.

The decrease in the BMUS harvest in 1997 is due to the few number of fishermen concentrating on the deep-water bottomfish fishery that particular year; whereas the increase in 1998 may have been the result of several relatively successful bottomfishing trips made by

several highliners to Bank A that year.

Source: The DAWR offshore creel survey data as expanded by computer-based algorithms by method of fishing. All unidentified catch was allocated to species categories based on the species percentage of the total catch.

Calculations: The estimated total landings of the bottomfish species are selected from the expanded creel survey species composition files. However, the expanded estimates of catch by species must include at least a portion of the catch identified only by generic species codes categories. These generic categories (e.g. "mixed shallow bottomfish") also include some non-BMUS bottomfish according to the FMP definition (e.g. squirrelfish).

Year	Total Bottomfish Harvest (lbs)	Total BMUS Harvest (lbs)
80	37399	19253
81	63654	42517
82	63442	43428
83	53404	39193
84	56998	32232
85	94318	68141
86	30368	17969
87	35033	24288
88	52791	33724
89	53272	39814
90	45374	31295
91	51329	29962
92	50099	34057
93	78355	48494
94	83367	49169
95	108741	44135
96	137790	54122
97	125801	29243
98	96648	44097
Average	69378	38165
Std. deviation	30789	12307

Figure 2a. Total and commercial BMUS harvest

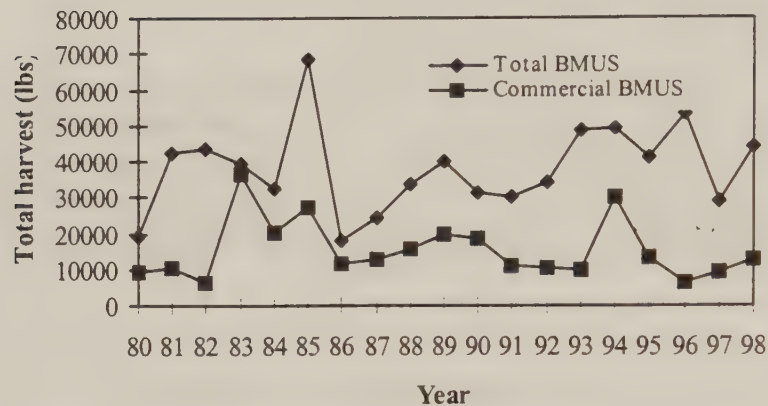
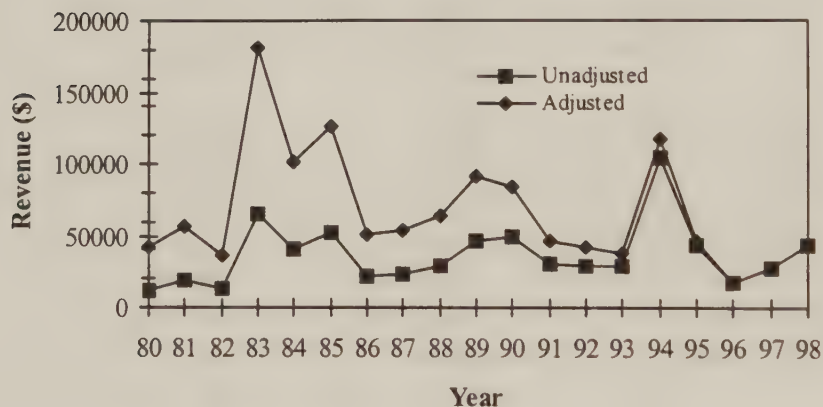


Figure 2b. Total and commercial BMUS revenue



Interpretations: Guam's highliner fishermen have generally been responsible for the peaks in commercial BMUs landings, as was the case in 1983, 1985, 1994 and in 1998. For example, the nearly 300% increase in 1994 of the commercial BMUS harvest and revenue over the previous year's figure, is the result of highliner vessels entering (or reentering) into the fishery during that year. The 39% reduction in BMUS harvest and 56% decline in commercial harvest for 1995 are best explained by the absence or reduced effort of about six highliners who combined, have landed an average of 18% of the total BMUS harvests between 1992 and 1996, and 68% of the unexpanded commercial landings for the same period. Harvest records for these six highliners indicate a 45% reduction in 1995 of their total bottomfish harvest, dropping from 13,349 pounds in 1994, down to 6,023 pounds in 1995. This decline in highliner landings accounts for about two-thirds of the 1995 reduction in commercial BMUS harvest.

The 1996 peak and 1997 46% decline in total BMUS harvest is believed to have been influenced more by weather conditions than any other factor: there were more calm water days in 1996 than in 1997.

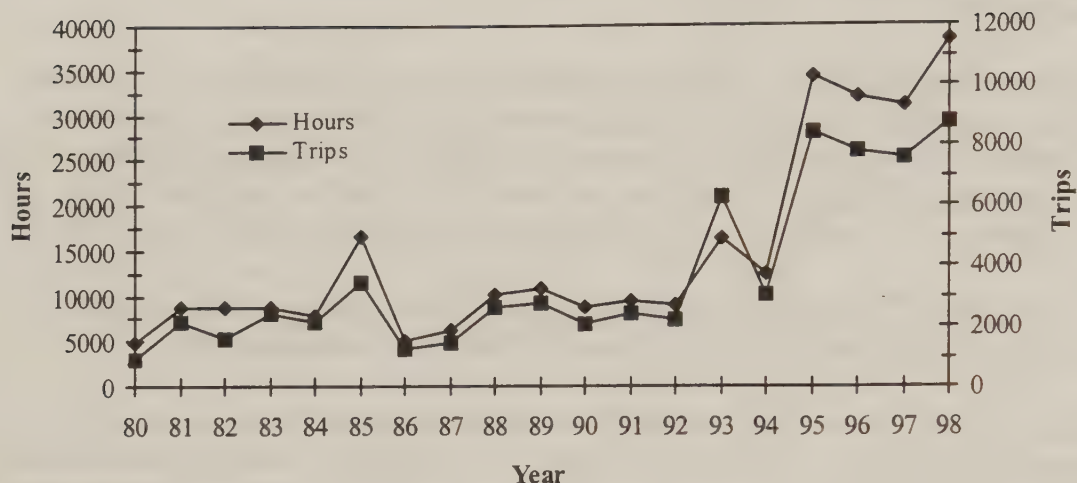
In 1996, commercial BMUS harvest and adjusted revenue dropped to its lowest point ever, owing in large part to the almost complete absence of highliner activity in the fishery. The slight increase in 1997 is attributed to one highliner fisherman who made several recorded trips to the rarely-fished "Bank A" located approximately 117 miles west of Guam. The increase in 1998 is likely the result of several highliners making multiple Bank A trips.

Source: The estimated total landings are from the DAWR creel survey system, and the commercial data are from the WPacFIN-originated commercial landings system.

Calculations: The total commercial bottomfish landings and revenue for each year were calculated by summing the weight and value fields in the commercial landings data base and then multiplying by an estimated percent coverage expansion factor. This annual expansion factor was subjectively created and includes an analysis of the "disposition of catch" data available from the DAWR offshore creel survey, an evaluation of the fishermen in the fishery and their entry and exit patterns, general dock-side knowledge of the fishery, status of marketing conditions and its structure, overall number of records in the data base, and a measure of the best-educated guess.

Year	Total BMUS Harvest (lbs)	Commercial BMUS Harvest (lbs)	Unadjusted Revenue (\$)	Adjusted Revenue (\$)
80	19253	9381	11458	41502
81	42517	10459	18590	55900
82	43428	6617	12753	36474
83	39193	36281	65543	181160
84	32232	20115	40176	102128
85	68141	27064	51777	126697
86	17969	11482	21289	50709
87	24288	12639	23551	53744
88	33724	15792	29568	64104
89	39814	19442	47029	91941
90	31295	18390	48983	83859
91	29962	10773	30234	46953
92	34057	10344	29410	41469
93	48494	10125	29348	38182
94	49169	30237	104827	116673
95	40924	13339	43929	46433
96	53572	6578	17492	17615
97	29243	9387	28070	28238
98	44097	13011	42966	42966
Average	37967	15340	36684	66671
Std. deviation	12202	8163	21927	40949

Figure 3. Estimated boat hours and trips



Interpretations: The almost three-fold increases in 1995 are largely the result of the nearly 60% increase in the number of boats, primarily recreational and subsistence, entering into the fishery that year, and a higher number of calm days throughout the year which enabled many of them to bottomfish more often than usual. The increase in boat trips and hours may have also been due to the establishment of the Agat Marina survey in 1994 which served to improve the estimation of the number of recreational/subsistence and charter boats bottomfishing out of this port, and the opening of boat slips at the marina that same year which enabled bottomfish charter boats to operate regularly out of this port. Interestingly, the charter boat component of the bottomfish fishery in 1996 accounted for 23% of the total number of bottomfishing trips, and 13% of the hours fished. Furthermore, the Agat Marina creel survey almost always includes several charter bottomfishing vessels making multiple trips on each survey day. The rash of typhoons that hit Guam between 1996 and 1997 may explain the slight declines in bottomfishing trips and hours during those years. A return to more normal weather patterns in 1998 best explains the increases last year.

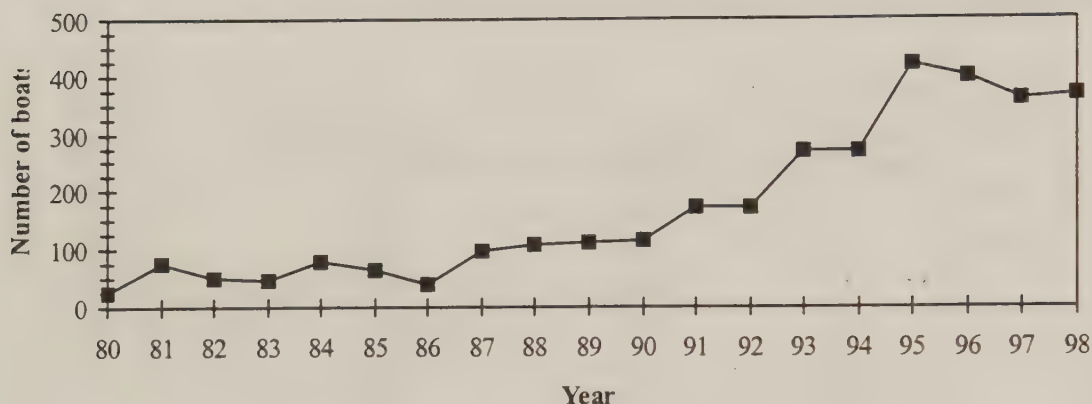
The extended periods of unusually calm seas throughout 1993 resulted in more boats bottomfishing more often and for longer periods, which best accounts for the spike in boat hours and trips recorded for that year. The apparent 1994 declines represent a return to normal weather and fishing conditions, but are still indicative of an increasing trend in the total number of boat trips and boat hours since 1986. The succession of typhoons and inclement weather that hit Guam between 1990 and 1992 may have suppressed the expected trend of a steady increase in the number of boat trips and boat hours during that period.

Source: The DAWR creel survey data for bottomfishing methods.

Calculations: The estimated number of boat trips and boat hours for bottomfishing methods are derived directly from the creel survey expansion algorithms.

Year	Hours	Trips
80	4752	929
81	8804	2150
82	8621	1606
83	8699	2401
84	7730	2160
85	16477	3471
86	5018	1246
87	6264	1447
88	10208	2653
89	10818	2732
90	8628	2060
91	9440	2444
92	9072	2234
93	16238	6265
94	12512	3056
95	34233	8399
96	31874	7790
97	31118	7604
98	38497	8765
Average	14684	3653
Std. deviation	10735	2633

Figure 4. Guam bottomfish fishery participation



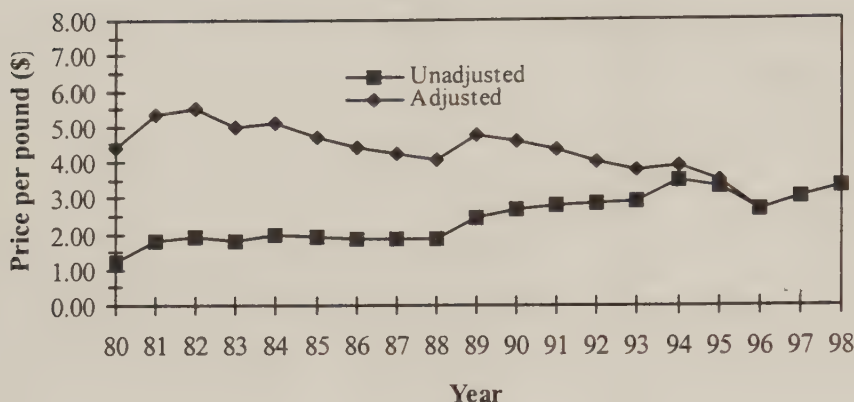
Interpretations: Over the last several years the number of boats participating in this fishery has leveled off. The approximately 57% increase between 1992 and 1994 is believed to be the result of an improvement in the sampling effort with the inclusion of the Merizo Pier as a survey site in 1991, and a healthy economy that made it possible for more residents to afford boats. Another 57% increase occurred in 1995 over the previous year due to another improvement in sampling effort with the inclusion of the Agat Marina as an offshore creel survey site in October, 1994. In general, most of the newcomers in the last five years are recreational and subsistence-type vessels who bottomfish only part-time and primarily target the shallow-water bottomfish complex.

Source: DAWR offshore creel survey boat log data from Agana Boat Basin, Agat Marina and Merizo Pier boat launch sites. The data was converted and processed using the WPacFIN-generated boat estimator model.

Calculations: The 1998 figure was obtained by first running the above-mentioned model 1,000 times using a randomly selected order of the days sampled at all three ports combined, then eliminating the upper and lower 25 estimates to rid the model of occasional outlier estimates; and finally calculating the mean and standard deviation for the remaining 950 estimates. The removal the outliers conducted in the second step lowered the original estimated number of boats after the model was run 1,000 times by about 1%, but more importantly, reduced the standard deviation by approximately 20%. Previous year's estimates were calculated using a similar conservative threshold C/E model which was run a minimum of 15 times per year.

Year	Number of Boats
80	24
81	75
82	49
83	48
84	79
85	63
86	39
87	96
88	107
89	110
90	116
91	173
92	173
93	271
94	268
95	422
96	400
97	358
98	367
Average	170
Std. deviation	134

Figure 5. Average bottomfish prices



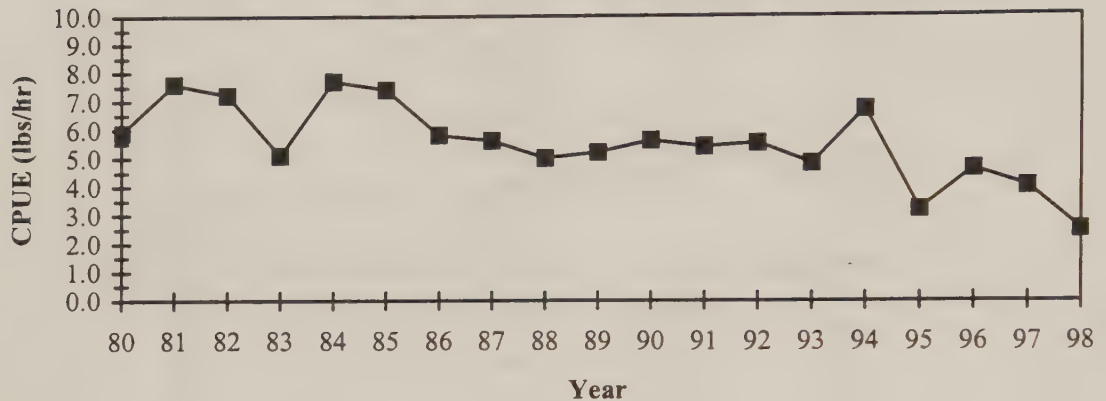
Interpretations: The adjusted average price for bottomfish has increased only slightly in the last couple of years and is likely the result of increased demand for a dwindling supply of fish. The slight decreases in 1995 and 1996 may have been the result a consistent supply of reasonably-priced fish and competition among vendors during those years. Imported fish from other islands around the region have over the years effectively discouraged local vendors from increasing the price of locally-caught bottomfish. The 1996 inflation-adjusted average bottomfish price of \$2.66 is the lowest ever recorded and may explain why local highliners were almost completely absent from the fishery around those years. The average price increased slightly in 1997 to \$2.99 per pound and rose even more in 1998 to \$3.30.

Source: The commercial landings data from the major wholesalers.

Calculations: The average price of all bottomfish species combined is calculated by dividing the total bottomfish revenue by the sold weight. The inflation adjustment is made by using the Consumer Price Index (CPI) for Guam and establishing the 1998 figure as the base from which to calculate expansion factors for all previous years (e.g. divide the 1998 CPI by the CPI for any given year), and then multiplying the unadjusted average price by this factor to obtain the adjusted average price for the given year. A new “market basket” was created by the Department of Commerce in 1998 which resulted in the CPI figure being reset again this year.

Year	Unadjusted \$/lb	Adjusted \$/lb
80	1.22	4.42
81	1.78	5.34
82	1.93	5.51
83	1.81	4.99
84	2.00	5.08
85	1.91	4.68
86	1.85	4.42
87	1.86	4.25
88	1.87	4.06
89	2.42	4.73
90	2.66	4.56
91	2.81	4.36
92	2.84	4.01
93	2.90	3.77
94	3.47	3.86
95	3.29	3.48
96	2.66	2.68
97	2.99	3.01
98	3.30	3.30
Average	2.40	4.24
Std. deviation	0.64	0.77

Figure 6. Guam Bottomfish CPUE



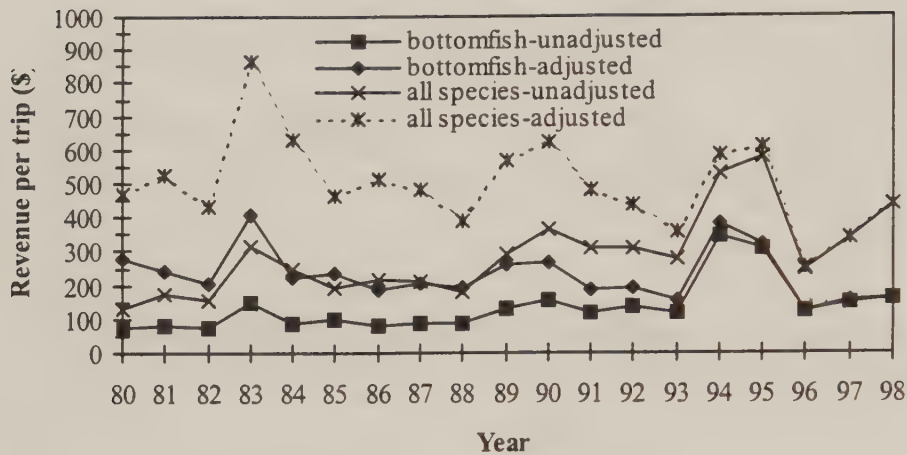
Interpretations: Historically, the annual CPUE has fluctuated around 5 to 8 pounds per hour and has up until the last four years remained fairly stable. In 1995 the CPUE fell to 3.2 pounds per hour, owing in large part to an increasing number of recreational and subsistence-type vessels continuing to enter into the fishery; most of which target the less-productive shallow-water complex of bottomfish in nearshore waters. The 1995 CPUE figure was less than half of the aggregate CPUE average of 6.9 pounds per hour for the first three years of data collection on Guam, placing the fishery in a yellow light condition for the first time ever. In 1996 however, the CPUE improved to 4.6 pounds per hour, thereby canceling this indicator of fishery stress. The CPUE decreased to 4.0 pounds per hour in 1997, and in 1998 dropped back into a yellow light condition as anticipated.

Source: The DAWR creel survey data for the bottom fishing method.

Calculations: The yearly catch-per-unit-effort (CPUE) is calculated by using the year-end survey totals and dividing the total weight of bottomfish landed by the total number of hours spent bottomfishing.

Year	CPUE (lbs/hr)
80	5.9
81	7.6
82	7.2
83	5.1
84	7.7
85	7.4
86	5.8
87	5.6
88	5.0
89	5.2
90	5.6
91	5.4
92	5.5
93	4.8
94	6.7
95	3.2
96	4.6
97	4.0
98	2.5
Average	5.5
Std. deviation	1.4

Figure 7. Guam average revenue per trip



Interpretations: The inflation-adjusted average revenue per trip for both the “bottomfish” and “all species” categories fell dramatically in 1996 and was likely due to fewer highliners participating in the fishery. Furthermore, some of the more experienced fishermen who use to sell their catch to vendors participating in the DAWR commercial receipt book program, may have chosen instead to market their catch on their own, or sold their catch to vendors who were not part of the commercial receipt book program. The increase in the amount of imported bottomfish from around Micronesia (Belau, Chuuk, Pohnpei, etc.) that began sometime around 1991 with the addition of frequent airline routes to Guam, may explain the slight decrease in revenues between 1991 and 1993. The substantial increases in the inflation-adjusted average revenue per trip in 1994 are best explained by the success of a few highliner vessels during that year. The general higher revenue levels for the “all species” category over the last decade suggests that most commercial fishermen on average continue to make more money from their trolling efforts than from bottomfishing, as emphasized by the disproportionately higher revenues earned in the last two years from fish other than bottomfish.

Source: The commercial landings data from major wholesalers.

Calculations: The average revenue per trip for all species is calculated by summing the revenue of all species sold for any trip which landed bottomfish species, and dividing by the number of trips. The average bottomfish revenue per trips is calculated from those same trips by summing the sales of only bottomfish species and dividing by the number of trips.

Year	\$/Trip (Bottomfish) unadjusted	\$/Trip (Bottomfish) adjusted	\$/Trip (All Species) unadjusted	\$/Trip (All Species) adjusted
80	77	280	129	468
81	80	239	174	525
82	71	204	152	435
83	147	406	312	862
84	87	221	248	631
85	96	236	190	464
86	78	186	215	511
87	88	202	212	484
88	87	190	178	387
89	132	258	290	567
90	154	263	363	622
91	120	186	308	479
92	134	190	311	439
93	118	153	277	360
94	346	385	528	588
95	306	324	578	611
96	121	122	250	251
97	151	152	338	340
98	163	163	439	439
Average	135	229	289	498
Std. dev.	74	76	122	134

Appendix 3

Hawaii

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Summary

None of the five BMUS species for which SPR values can be calculated have 1998 SPR values below the 20% critical threshold that defines recruitment overfishing under the FMP. Estimates range from a low of 24% for onaga to a high of 53% for uku when viewed on an archipelago-wide basis. Implementation of the state bottomfish management plan (which became law in June 1998) should bring an improvement to the locally depleted status of ehu and onaga in the MHI and thereby increase the archipelago-wide SPR estimates for these species.

The MHI bottomfish fishery, though showing signs of stress, has remained relatively stable over the last few years. Landings recorded to date for 1998 are lower than the revised landings reported for 1997. CPUE for the MHI is up from last year (194 lb/trip vs 164 lb/trip). Stocks of many of the BMUS species in this zone show clear signs of stress. Each of the BMUS species evaluated has a yellow light condition due to a drop in CPUE below 50% of original values. In addition, onaga and ehu stocks are severely depleted on a local basis as the MHI SPR values for these species are at or below 20% (5% and 9% for onaga and ehu, respectively). These SPR levels are below the critical threshold that would signify recruitment overfishing if present on a stock-wide basis and demand immediate action (state bottomfish management measures, when implemented, should meet this need). Hapuupuu SPR values calculated for the MHI are 22% for 1997 (revised upward from 18% reported last year when calculations were based on incomplete reporting) and 24% for 1998.

Bottomfish resources in the NWHI remain relatively healthy. CPUE on a per trip basis dropped to 42% of the original level in the Mau Zone (down 24% from the 1997 level) and 68% in the Hoomalu zone (essentially the same as the 1998 value). On a per day basis CPUE values are down 8% in the Mau zone and 7% in the Hoomalu. Analysis of SPR and percent immature in the catch show no localized depletion problems to date for any BMUS species in either zone, however, the mean weight of onaga in the Mau zone did drop dramatically in 1998.

Armorhead stocks outside of the US EEZ experienced a short pulse in recruitment in 1992 which did not carry over into 1993. The 1993 SPR values at Southeast Hancock Seamount are the highest recorded since 1986, but at 2.5%, they still indicate a collapsed fishery. Data for Hancock Seamount has not been available since 1994, but is available for areas outside of the US EEZ for years through 1997 (1998 values are not yet available). SPR values obtained at Colahan Seamount have been shown to correlate well with values from Hancock Seamount and can be used as a proxy value. The 1997 SPR for Colahan Seamount was 1.1%, indicating a collapsed fishery.

Historical Annual Statistics
Main Hawaiian Islands

Year	Total Landings (lbs)	CPUE (lbs/trip)	Inflation Adjusted Revenue	Price per Pound	Number of Vessels	SPR Average
1986	810,348	274	\$3,354,000	\$4.43	538	33
1987	783,569	237	\$3,648,000	\$4.88	535	25
1988	1,164,492	329	\$4,828,000	\$4.36	572	37
1989	1,006,142	361	\$4,296,000	\$4.57	537	40
1990	645,802	245	\$2,910,000	\$4.88	501	27
1991	547,800	202	\$2,074,000	\$4.06	469	24
1992	587,471	228	\$2,130,000	\$3.93	407	25
1993	347,960	213	\$1,722,000	\$4.04	403	24
1994	457,956	217	\$1,963,000	\$4.00	423	24
1995	439,625	193	\$1,946,000	\$3.73	400	22
1996	439,867	172	\$1,669,000	\$4.11	466	21
1997	512,554	164	\$1,669,000	\$3.47	495	20
1998	461,528	194	\$1,629,000	\$3.52	480	21
Ave.	631,163	233	\$2,602,923	\$4.13	479	26
s.d.	244,231	58	\$1,094,742	\$0.47	58	6

Historical Annual Statistics Mau Zone						
Year	Total Landings (lbs)	CPUE (lbs/trip)	Inflation Adjusted Revenue	Price per Pound	Number of Vessels	SPR Average
1986	NA	2,206	NA	NA	NA	41
1987	NA	2,889	NA	NA	NA	50
1988	NA	2,136	NA	NA	4	37
1989	118,000	4,463	\$433,000	\$3.67	5	91
1990	249,000	3,435	\$817,000	\$3.28	14	77
1991	103,000	1,199	\$365,000	\$3.54	14	42
1992	71,000	1,273	\$243,000	\$3.42	8	38
1993	98,000	1,321	\$300,000	\$3.06	8	36
1994	160,000	1,573	\$525,000	\$3.28	12	68
1995	166,000	1,635	\$498,000	\$3.00	10	45
1996	135,000	1,543	\$437,000	\$3.24	13	53
1997	105,000	1,976	\$369,000	\$3.51	9	62
1998	66,000	1,689	\$182,000	\$2.77	7	54
Ave.	127,100	2,103	\$416,900	\$3.28	9	53
s.d.	54,157	961	\$177,351	\$0.28	3	17

**Historical Annual Statistics
Hoomalu Zone**

Year	Total Landings (lbs)	CPUE (lbs/trip)	Inflation Adjusted Revenue	Price per Pound	Number of Vessels	SPR Average
1986	NA	5,301	NA	NA	NA	75
1987	NA	8,187	NA	NA	NA	113
1988	NA	4,702	NA	NA	12	66
1989	184,000	5,481	\$616,000	\$3.35	5	70
1990	173,000	5,403	\$564,000	\$3.26	5	64
1991	283,000	5,871	\$894,000	\$3.16	4	82
1992	353,000	9,464	\$1,193,000	\$3.38	5	98
1993	287,000	8,412	\$961,000	\$3.35	4	109
1994	283,000	6,903	\$973,000	\$3.44	5	64
1995	202,000	6,130	\$636,000	\$3.15	5	73
1996	176,000	6,216	\$604,000	\$3.43	3	78
1997	241,000	6,351	\$769,000	\$3.19	6	65
1998	266,000	5,315	\$779,000	\$2.93	7	68
Ave.	244,800	6,441	\$798,900	\$3.26	6	79
s.d.	59,896	1,425	\$204,230	\$0.16	2	17

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Introduction

The commercial bottomfish stocks in the Hawaiian Islands are divided into two fisheries: seamount groundfish and deep-slope bottomfish. The seamount fishery targets alfonsin, *Beryx* spp., and armorhead, *Pseudopentaceros wheeleri*. The only area in the US EEZ for this fishery is Southeast Hancock Seamount located 1,400 nm northwest of Honolulu. This trawl fishery was started by the Russians and Japanese in the late 1960s and large catches were made for about 10 years until they caused a crash in the fishery. This fishery has never been domestically harvested. A moratorium on fishing within the US EEZ began in 1986 and continues through the present as no substantial recovery in the fishery has been observed.

The deep-slope bottomfish fishery in Hawaii concentrates on species of eteline snappers, carangids, and a single species of grouper concentrated at depths of 30-150 fathoms. These fish have been fished on a subsistence basis since ancient times and commercially for at least 90 years. The deep-slope fishing grounds within the US EEZ are divided into three management zones. The inhabited main Hawaiian Islands (MHI) support numerous subsistence, recreational, and commercial fishermen with considerable overlap by category. The uninhabited Northwestern Hawaiian Islands (NWHI) are divided into the Mau Zone, closer to the MHI, and the Hoomalu Zone. Fishing in these zones is conducted solely by commercial fishermen and requires federal licensing for such activities. The Hoomalu Zone is a limited entry zone with 7 vessels participating in 1998; 7 vessels fished the Mau Zone in the same year.

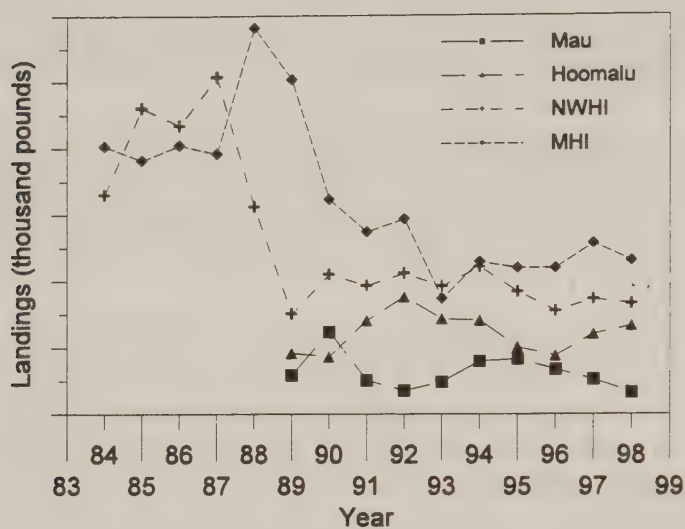
Vessel size varies considerably with larger fully commercial vessels (30 ft in length and over) conducting trips of about 10 days, and smaller vessels (<30 ft) generally restricted to the MHI and trips of 1-3 days. Most vessels in this fishery are fully outfitted with electronic navigation and fish-finding equipment, as well as with electric or hydraulic line-hauling equipment. The catch is sold fresh in the round for local consumption.

Catch and revenue data for bottomfish have been collected by the State of Hawaii Division of Aquatic Resources (HDAR) since 1948 in the form of a report submitted by commercial fishermen. No data is collected for recreational or subsistence fishermen, but their catch is estimated to be about equal to the commercial catch in the MHI. Data obtained from a market monitoring program and data from fishermen interviews are combined with the HDAR data set for most of the analysis presented in this report.

Recommendations

- 1) The BPT recommends that the Council amend the FMP to become fully consistent with the State of Hawaii Administrative Rule 13-94 on MHI bottomfish. This would include closure of areas within the federal jurisdiction as specified in the administrative rule.
- 2) The BPT recommends that the council encourage and assist the State of Hawaii DLNR in the implementation of a postcard survey of non-commercial bottomfish fishermen as determined from the State's BF vessel identification permit list. This survey would be used to estimate recreational catch of bottomfish in the MHI.

Figure 1. Hawaii's bottomfish landings from the NWHI and MHI



Year	Landings (1000 lb)			
	Mau	Hoomalu	Total NWHI	MHI ²
1984	NA	NA	661	807
1985	NA	NA	922	763
1986	NA	NA	869	810
1987	NA	NA	1015	783
1988	NA	NA	625	1164
1989	118	184	303	1006
1990	249	173	421	646
1991 ¹	103	283	387	548
1992 ¹	71	353	424	587
1993 ¹	98	287	385	348
1994 ¹	160	283	443	458
1995 ¹	166	202	369	440
1996 ¹	135	176	311	440
1997 ¹	105	241	346	513
1998 ¹	66	266	332	462 ³
Average	127.10	244.80	520.87	929.07
Standard Deviation	54.16	59.90	238.95	1046.68

¹ NWHI data from combination NMFS and HDAR

² Data from HDAR

³ Preliminary data expanded for full year estimate

Source: Data are primarily from HDAR and supplemented with data from NMFS market monitoring program. Data are only those from BMUS and other bottomfish species. Pelagic species data were not included.

Calculation & Adjustment: The HDAR integrated data set was supplemented with a very limited amount of NMFS market monitoring data. The HDAR integrated data set provides the most complete data set dealing with the activities and landings of the diverse Mau zone fishing fleet. Collection of data by both HDAR and NMFS provides good coverage of the NWHI bottomfish fleet and also provides opportunities for the cross-checking of trip and landing information.

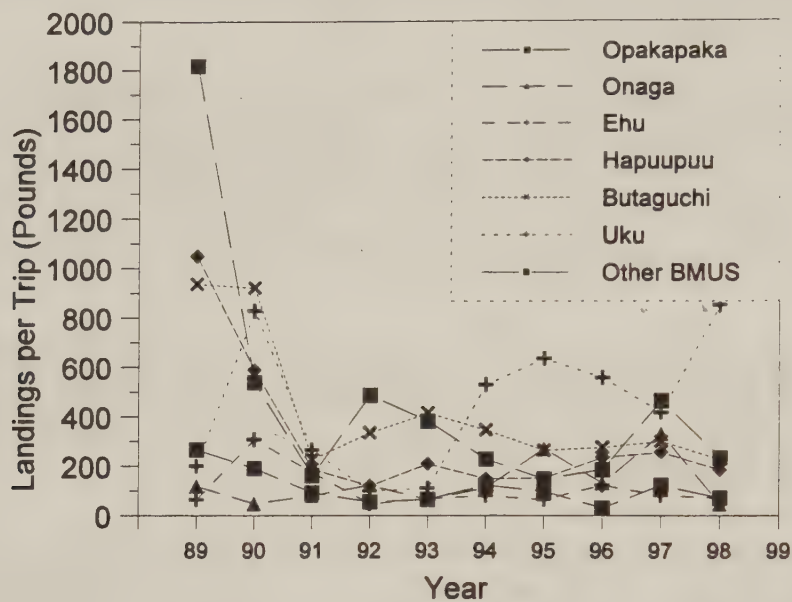
Data in this report are only from those trips that were directed at bottomfish species or in which bottomfish gear was used (zero catch trips or efforts were included). Trolling only trips to the NWHI that were not targeting BMUS are not included. Trolling only trips that resulted in BMUS being caught were included.

Comments & Interpretation: NWHI landings data shows a minimal decrease from 1997 values. The decrease was mainly due to the Mau zone activity in which there was a 26% drop in number of trips (Fig. 4). Additionally there was a 14% decrease in BMUS landings per trip. Hoomalu zone also experienced a decrease in BMUS landings per trip (Fig. 2) of 16% but an increase of 31% in the number of trips has bolstered the increase in the BMUS landings by 10%.

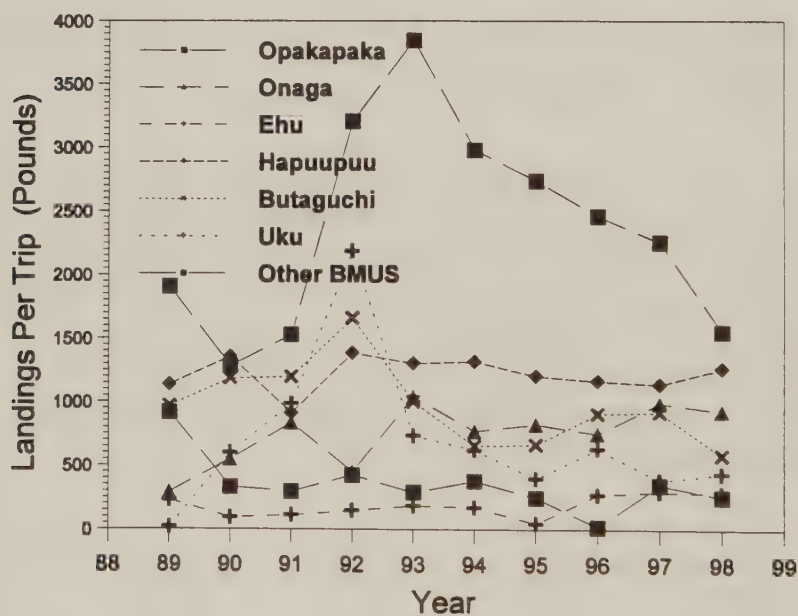
Hoomalu zone landings have increased in the last two years due to an increasing number of trips and vessels. In mid-1997 there was an addition of 2 vessels into the Hoomalu zone fleet. These additions combined to increase the 1998 effort and landings.

Mau zone landings continue to decline in 1998. The decline that had started in 1997 is related to the effects of a highliner vessel leaving the Mau zone fishery late in 1997 and entering the Hoomalu zone fishery. The effect on the Mau zone landings can clearly be seen in 1998. This same vessel had previously entered the Mau zone fishery in 1994 whereupon it made an immediate impact on the volume of landings which continued through 1997. The landings have not only slumped to less than 1993 levels but are now less than those since the creation of the Mau zone in 1989. The remaining Mau zone vessels are now primarily part-time and combination troll/bottomfish multi-fishery vessels.

Figure 2. Northwestern Hawaiian Islands BMUS species composition of landings per trip



NWHI BMUS average pounds per trip by species, Mau Zone



NWHI BMUS average pounds per trip by species, Hoomalu Zone

Species	1989	1990	1991 ¹	1992 ¹	1993 ¹	1994 ¹	1995 ¹	1996 ²	1997 ²	1998 ²
Opakapaka	1820	541	163	488	382	229	149	187	465	235
Onaga	120	49	83	124	66	114	270	132	331	47
Ehu	65	309	176	48	69	81	65	123	82	72
Hapuupuu	1050	590	189	121	210	150	153	235	257	184
Butaguchi	938	923	228	336	415	346	264	276	300	227
Uku	202	830	266	100	112	529	635	558	417	852
Other BMUS	268	193	94	56	67	124	99	32	124	72
Total per trip	4463	3435	1199	1273	1321	1573	1635	1543	1976	1689

¹ Data from combination of NMFS and HDAR data sets.

² Data from HDAR data set.

Species	1989	1990	1991 ¹	1992 ¹	1993 ¹	1994 ¹	1995 ¹	1996 ²	1997 ²	1998 ²
Opakapaka	1910	1284	1530	3208	3849	2984	2741	2426	2258	1556
Onaga	293	550	837	450	1042	771	825	752	993	931
Ehu	231	94	113	148	185	172	47	272	298	285
Hapuupuu	1138	1357	913	1386	1305	1318	1206	1166	1141	1266
Butaguchi	969	1185	1196	1660	1004	655	665	909	923	583
Uku	20	600	985	2187	736	623	397	632	387	438
Other BMUS	920	333	297	425	291	380	249	21	351	256
Total per trip	5481	5403	5871	9464	8412	6903	6130	6216	6351	5315

¹ Data from combination of NMFS and HDAR data sets.

² Data from HDAR data set.

Source: The 1998 data are primarily from HDAR and supplemented with data from NMFS market monitoring program. Data are only those from BMUS. Pelagic species data were not included.

Calculation & Adjustment: The HDAR integrated data set was supplemented with a very limited amount of NMFS market monitoring data (1 trip). The BMUS data were totaled by zone and divided by the number of trips to each zone.

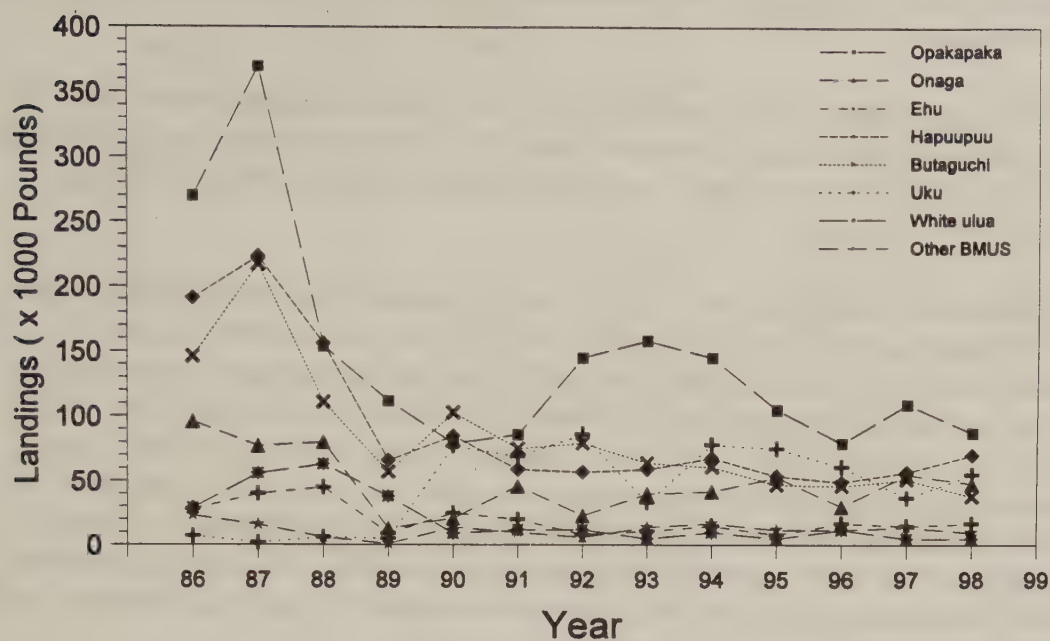
Comments & Interpretations: Mau zone BMUS landings per trip has decreased in 1998. Mau zone per trip landings of BMUS has decreased 14% from 1997 levels. The majority of BMUS have experienced individual decreases of 12%-49%. Only uku landings, which increased 104%, have risen to compensate for the decrease in other species landings.

Onaga and opakapaka landings which had risen to new highs in 1997 have suffered greatly with decreases of 86% and 49% respectively. The large volume of uku landings indicate an increase

in the availability of uku in the Mau zone which prompted a targeting switch away from onaga and opakapaka. The decrease in the landings of onaga and opakapaka was not unexpected as a highliner vessel did exit the fishery late in 1997.

Hoomalu zone per trip landings have decreased 16% in 1998. Butaguchi, opakapaka, and the Other BMUS categories had the largest decreases in landings. Only uku and hapuupuu landings have increased but not substantially. As noted in Fig. 1, the Hoomalu zone landings have shown an overall increase which resulted from an increase in the number of trips made (Fig. 4).

Figure 3. NWHI BMUS species composition of landings by weight



Data table for Figure 3 (in thousands of pounds)

Species	1987	1988	1989	1990	1991 ¹	1992 ¹	1993 ¹	1994 ¹	1995 ¹	1996 ²	1997 ²	1998 ²
Opakapaka	370	154	112	79	86	145	158	145	105	79	109	87
Onaga	77	80	13	21	46	23	40	42	53	30	55	48
Ehu	40	45	9	25	20	8	11	15	8	17	15	17
Hapuupuu	223	156	66	85	59	57	59	68	54	49	57	70
Butaguchi	217	111	57	103	75	79	64	61	47	46	51	38
Uku	2	6	5	77	69	86	33	78	75	61	37	55
White ulua	56	63	38	9	12	12	5	10	5	12	5	5
Other BMUS	16	6	1	14	10	6	14	17	12	12	14	10

¹ Data from a combination of NMFS and HDAR data.

² Data from HDAR data set.

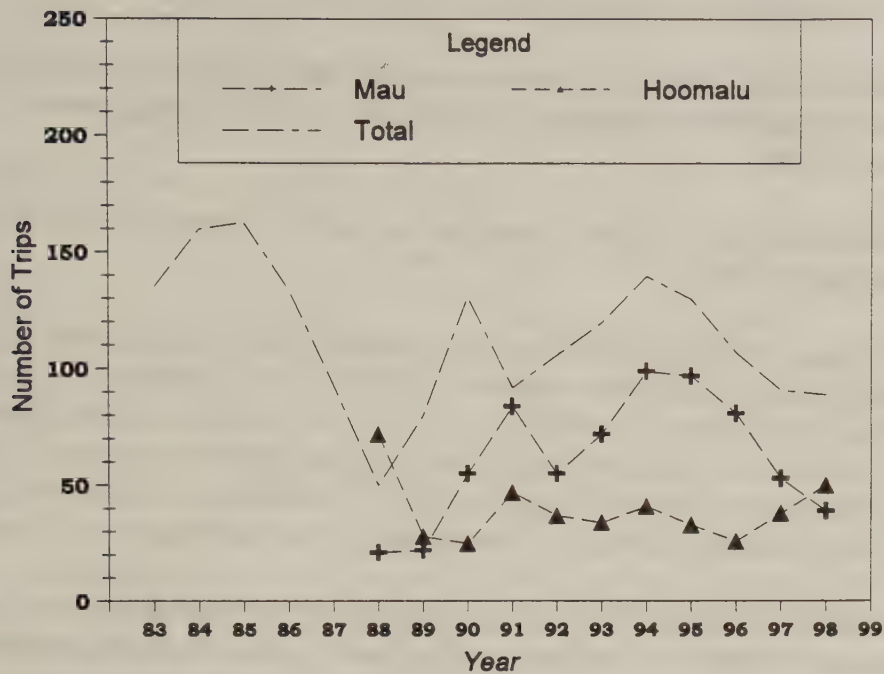
Source: Data for 1998 is mainly from the HDAR integrated data set. Data for 1991-1995 are from a combination of HDAR and NMFS market monitoring program. Data from 1987-1990 are expanded NMFS estimates.

Calculation & Adjustment: HDAR data was supplemented with little additional data (1 trip) from the NMFS data set.

Comments & Interpretation: The overall trends of the NWHI bottomfish fishery show that landings of BMUS have continued to decrease since 1988. The 1998 landings are only 4% less than in 1997. The 37% decrease in Mau zone landed volume was not quite offset by the Hoomalu zone's 10% increase.

The largest decreases in landings were for Other BMUS, butaguchi, opakapaka, and onaga categories. The uku, hapuupuu, and ehu volumes were the only ones to show an increase. Uku landings which increased by about 18,000 lbs(up 49%) indicates an increased abundance of this species. In the past increased abundances of any species generally have changed the targeting efforts of the fleet. An abundance of uku usually means less time targeting the usual target species of onaga and opakapaka which shows up as decreased landings. An example of this is seen in the landings during 1997 when the uku and white ulua landings showed the largest decline while most of the other targeted BMUS showed an increase. This trend is probably due to the effects of species availability and the fishermen consequently targeting on the most readily available species of value.

Figure 4. Number of trips made by NWHI bottomfish fleet, Mau and Hoomalu Zones



Year	Trips		
	Mau	Hoomalu	Total
1984	NA	NA	135
1985	NA	NA	160
1986	NA	NA	163
1987	NA	NA	134
1988	21	72	93
1989	22	28	50
1990	55	25	80
1991 ¹	84	47	131
1992 ¹	55	37	92
1993 ¹	72	34	106
1994 ¹	99	41	140
1995 ¹	97	33	130
1996 ²	81	26	107
1997 ²	53	38	91
1998 ²	39	50	89
Average	61.64	39.18	113.40
Std. Dev.	27.43	13.53	31.64

¹ Based on combined NMFS and HDAR data.

² Based on HDAR data.

Source: Data for 1998 was primarily from HDAR supplemented with NMFS data. Data for 1991-1995 are from a combination of HDAR and NMFS market monitoring program and the HDAR fast-track data system. Data from 1986-1990 are NMFS estimates.

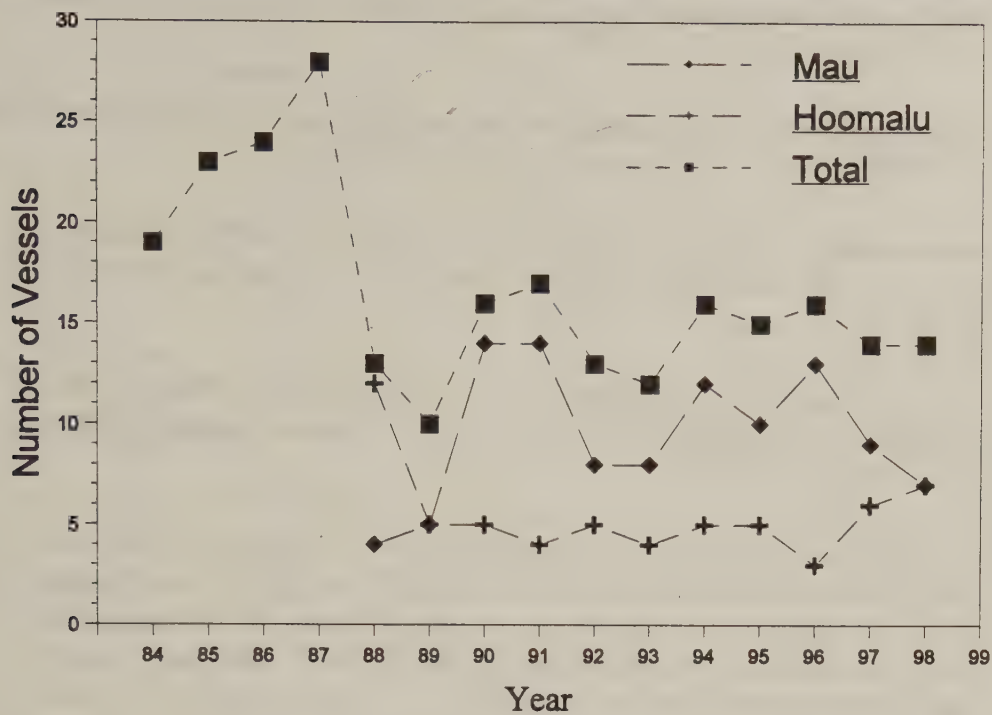
Calculation & Adjustment: HDAR trip data was supplemented with an additional NWHI trip from the NMFS market monitoring program. The data for 1995 have been updated. The trips were totaled by area fished.

Comments & Interpretation: The overall trend in the number of trips to the NWHI areas has been one of decline since 1994.

The number of Hoomalu zone fishing trips has been trending upwards as the number of vessels also has increased (Fig. 5). The increase started with the mid-1997 addition of 2 new vessels. This follows the poor participation in 1996 during which time participation dwindled to just 3 full time vessels. The number of vessels fishing in the access restricted Hoomalu zone had remained relatively constant at 4-6 vessels per year since 1989 when the limited entry plan went into effect. The average number of trips per vessel seems to have stabilized at 6-8 per year.

The number of trips to the Mau zone has been declining since 1994 and remains below those of the 1990-1997 seasons. Many of the Mau zone participants are not strictly bottomfish fishermen. Instead they are targeting pelagic species more often than they target bottomfish species. Some trips are trolling only trips that also catch uku and white ulua. There have many more trips that are directed at the weather bouys and Mau zone banks for troll and other activities such as palu ahi, ikashibi, and kona crabbing. Species availability on these trips of short duration may be the driving factor in the decision to do the multiple target trips.

Figure 5. Number of vessels in the NWHI bottomfish fleet, Mau and Hoomalu Zones



Year	Boats		
	Mau	Hoomalu	Total ²
1984	NA	NA	19
1985	NA	NA	23
1986	NA	NA	24
1987	NA	NA	28
1988	4	12	13
1989	5	5	10
1990	14	5	16
1991 ¹	14	4	17
1992 ¹	8	5	13
1993 ¹	8	4	12
1994 ¹	12	5	16
1995 ¹	10	5	15
1996 ³	13	3	16
1997 ³	9	6	15
1998 ³	7	7	14
Average	9.45	5.55	16.73
Std. Dev.	3.47	2.38	4.89

¹ Based on a combination NMFS and HDAR data set.

² Total may not match sum of areas due to vessel participation in multiple areas.

³ Based on HDAR data.

Source: Data for 1998 was primarily from HDAR. Data for 1991-1995 are from a combination of HDAR and NMFS market monitoring program and the HDAR fast-track data system. Data from 1984-1990 are NMFS estimates.

Calculation & Adjustment: The 1997 vessel participation information was from the HDAR fast-track system. The number of vessels were totaled by area fished.

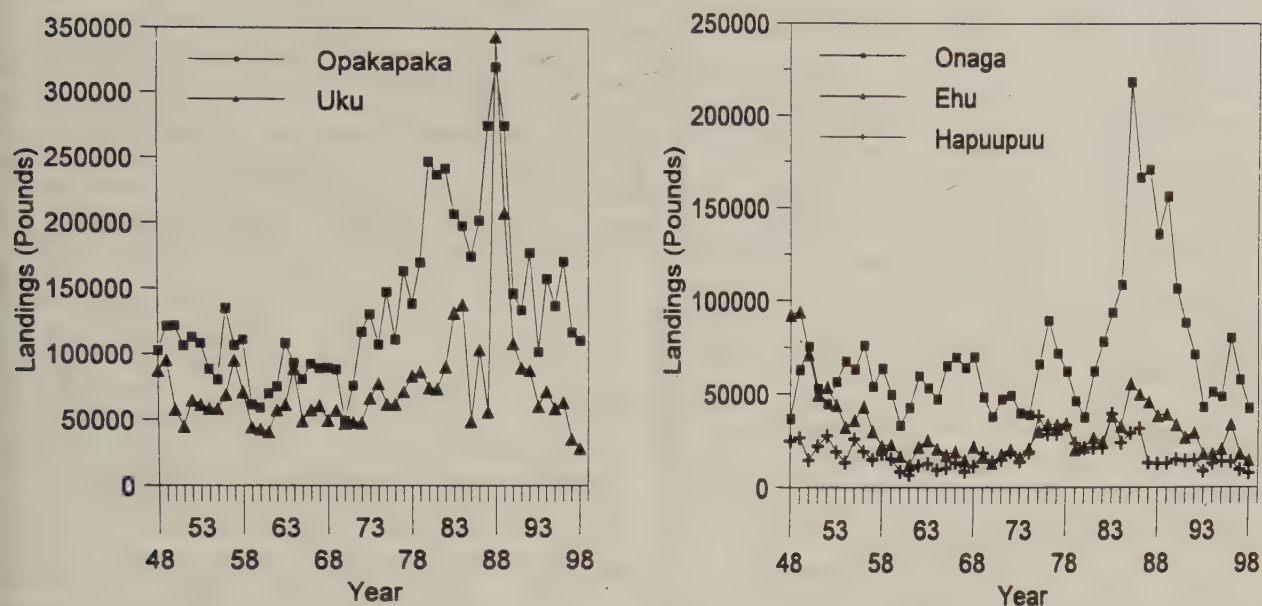
Comments & Interpretation: The total number of participants has dropped for two years running and is now at 14. The overall trend in the number of vessels fishing in the NWHI areas is one of stability for the last 5 years.

The Hoomalu zone participation has increased by one vessel in 1998 to a total of 7 after increasing by 3 the previous year. As a result, the number of trips have steadily increased during the last 2 years.

The Mau zone participation has decreased by 2 vessels in 1998. The Mau zone has always been more dynamic zone in terms of vessel participation. Originally the open access designation was to allow vessel operators to accumulate the experience before fishing the farther reaches of the NWHI. Thus owners and operators of smaller vessels from the MHI could gain valuable experience and decide if they would like to eventually fish the upper limited access zone. In 1996 due to fishermen's economic concerns the Mau Zone Task Force was formed to address the problem and suggest possible solutions. The Task Force has since moved in the direction of a limited entry fishery much like the Hoomalu zone. Subsequently the 1997 moratorium on additional new participants has essentially capped the fleet pending new regulations to be put in place in 1998. The moratorium itself had reduced the number of vessels from 13 in 1996 to 9 in 1997.

The new limited entry regulations and its initial qualification criteria will be in effect in mid-1999. It will allow all qualifying participants initial entry after which a "use it or lose it" criteria will allow the managers to reduce the fleet to its target number. The number of initial entrants is expected to inflate participation by a substantial number for an unknown number of years before the fleet is reduced to the target number. It is expected that the reduction will occur rapidly as the Mau zone has historically had a large turnover in annual participation.

Figure 6. MHI species composition of landings by weight



Interpretation: Most species show declining trends continuing from the mid- and late-eighties. The prevailing interannual pattern in landings is episodic versus predictably periodic or constant. 1998 landings for all species, with the exception of opakapaka are well below their long-term average landings.

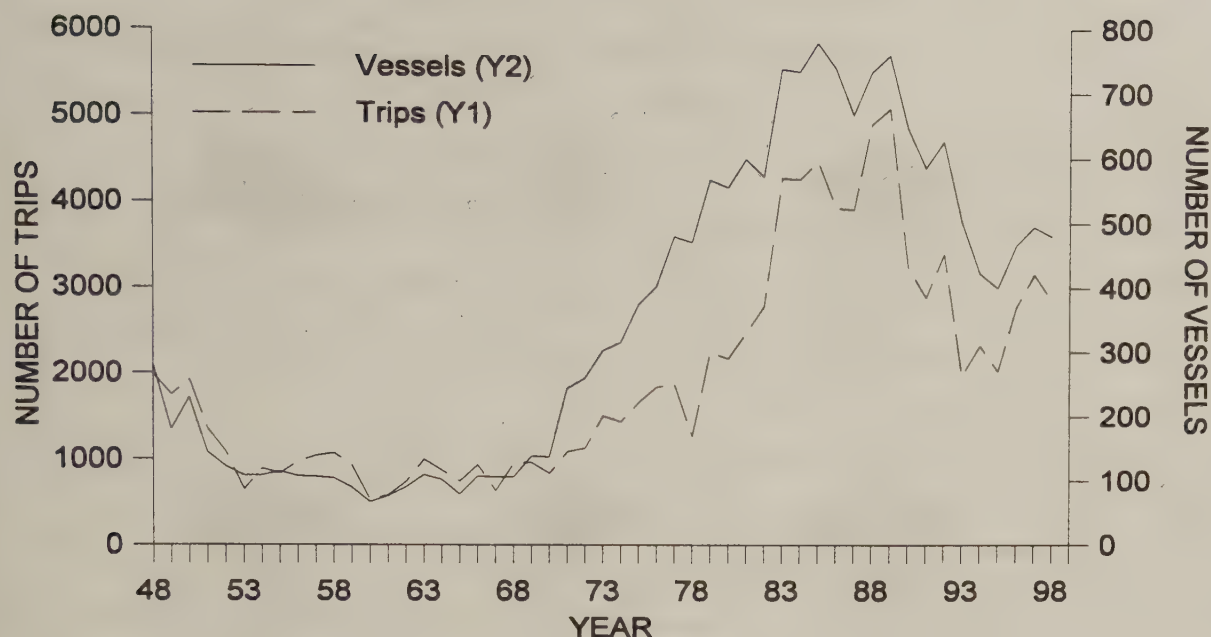
Source: Total commercial landings by species are from HDAR commercial catch report data for the MHI with no screening by gear. 1997 values have been updated from last year's report with an essentially complete data set for that year. 1998 values are preliminary estimates of annual landings based on landings reported to date and should increase for all species by an unknown amount.

Comments: Landings presented here are commercial reported landings only and do not include any expansion for recreational landings.

MHI Landings by Species

YR	OPA	ONA	EHU	UKU	HAP	YR	OPA	ONA	EHU	UKU	HAP
1948	102,651	36,804	92,323	87,235	24,609	1975	147,755	66,029	30,155	62,117	38,140
1949	121,243	62,979	94,097	95,273	26,397	1976	111,520	89,518	33,788	62,165	28,214
1950	121,664	75,398	71,286	57,814	14,514	1977	163,813	71,747	33,689	71,915	28,540
1951	106,423	53,018	49,699	45,065	22,000	1978	138,931	62,208	34,333	83,798	33,271
1952	112,917	44,604	53,716	64,799	27,499	1979	170,180	46,271	20,339	87,128	23,538
1953	108,504	56,506	44,200	61,619	19,009	1980	247,378	37,489	21,712	74,782	20,962
1954	88,641	67,583	32,278	58,767	13,367	1981	237,254	62,351	26,900	73,921	21,178
1955	80,516	63,208	36,017	58,564	25,849	1982	241,977	78,372	24,542	90,793	21,263
1956	134,980	75,986	43,313	69,108	19,224	1983	207,345	94,082	38,793	131,860	39,447
1957	106,656	53,988	30,157	95,267	14,782	1984	198,260	109,046	33,022	138,313	24,019
1958	111,131	63,774	22,309	71,321	18,033	1985	174,746	218,552	56,039	49,264	29,055
1959	62,043	49,745	23,107	44,705	15,294	1986	202,467	167,112	50,259	104,047	31,626
1960	59,405	33,158	16,950	43,186	8,418	1987	274,929	171,416	46,018	56,753	13,232
1961	70,083	42,701	12,370	41,134	6,642	1988	320,601	136,641	38,547	344,128	12,838
1962	75,492	59,788	21,742	57,568	11,663	1989	275,167	156,952	39,393	208,171	12,954
1963	108,505	53,225	25,267	61,601	12,865	1990	146,861	107,514	33,848	108,840	14,934
1964	93,618	47,325	20,914	89,156	9,321	1991	134,326	88,978	26,902	90,272	14,216
1965	81,039	65,040	17,605	49,485	10,297	1992	178,014	71,715	29,461	88,474	14,454
1966	92,815	69,634	19,342	57,849	13,277	1993	102,514	43,141	17,981	60,910	8,593
1967	89,364	64,022	14,899	60,970	8,480	1994	158,276	51,502	18,000	72,133	12,712
1968	89,908	69,922	21,984	49,677	11,287	1995	137,473	48,948	20,689	59,036	13,819
1969	88,621	48,454	16,483	57,542	18,300	1996	171,428	80,953	33,925	63,792	13,723
1970	49,655	37,894	13,364	47,443	13,651	1997	117,153	58,072	18,077	35,599	9,522
1971	76,388	47,250	17,626	48,710	14,746	1998	111,022	42,616	14,651	28,647	7,647
1972	117,367	49,213	20,347	48,077	18,994	ave.	136,424	71,199	31,565	76,737	18,023
1973	130,785	39,811	16,336	66,875	13,878	s.d.	60,982	38,155	17,816	48,349	7,906
1974	107,828	38,883	21,015	77,939	18,874						

Figure 7. MHI reported effort and participation



Interpretation: Updated data for 1997 show that reported effort and participation rose slightly instead of dropped from 1996 values and are both higher than their long-term means, but much lower than their peaks of the mid 80's. Preliminary 1998 values for effort and participation are based on reports received to date and not expanded for any late reporting. These values are slightly lower than 1997 values but are expected to rise as late reports are submitted.

Landings and CPUE for bottomfish trips are tabulated in the following table. These figures differ from those presented in Figure 1 (landings) and Figure 15 (CPUE). Those presented here are screened for bottomfish trips only (as defined below). In Figure 1 landings are for bottomfish species caught on all gears without screening criteria and in Figure 15 data are further screened by area fished and landings of individual fishers to reflect the effective fishing effort required to "standardize" CPUE. 1998 values for each are below their long-term averages, with that for CPUE being by far the lowest on record. It is always a bad sign when landings and CPUE both drop, indicative of resource depletion.

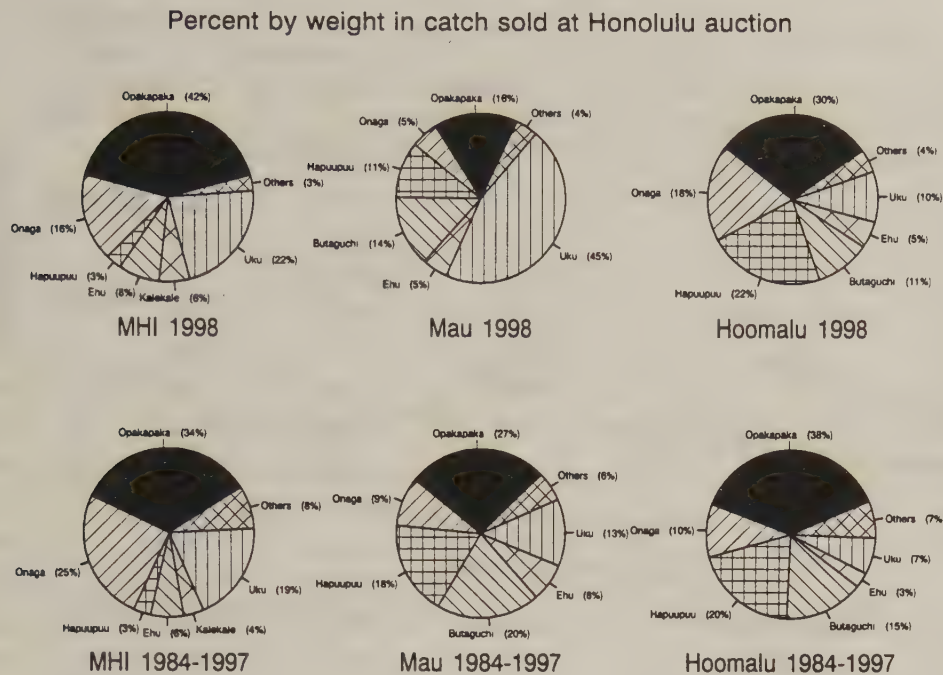
Source: HDAR commercial catch report data.

Calculation & Adjustment: MHI commercial bottomfish trip and vessel values are obtained from the HDAR C3 report data. Participation (# of vessels) is presented as the number of unique license numbers reporting bottomfishing trips for a particular year. For 1948-1993 the reported value for participation is based on the State fiscal year (July-June). For 1994-1997 the participation is reported on a calendar year basis. Trips qualify as bottomfish trips if they use bottomfish handline gear and at least 90% of the catch is of BMUS species.

Yr	# Ves	# Trip	Tot.Lbs	Lbs/Trip
1948	207	1,987	323,858	162.99
1949	196	1,751	338,406	193.26
1950	164	1,924	302,137	157.04
1951	126	1,355	282,271	208.32
1952	110	1,091	232,235	212.86
1953	106	650	123,867	190.56
1954	103	894	233,557	261.25
1955	108	836	197,757	236.55
1956	106	975	257,183	263.78
1957	102	1,041	239,485	230.05
1958	96	1,075	238,138	221.52
1959	76	929	213,322	229.63
1960	69	527	148,339	281.48
1961	65	586	171,768	293.12
1962	98	742	219,203	295.42
1963	110	1,001	290,690	290.40
1964	87	876	297,039	339.09
1965	85	750	237,624	316.83
1966	97	940	274,293	291.80
1967	99	641	236,588	369.09
1968	116	959	252,305	263.09
1969	130	964	232,754	241.45
1970	219	841	169,792	201.89
1971	198	1,093	173,001	158.28
1972	185	1,135	194,967	171.78
1973	238	1,511	246,341	163.03
1974	241	1,442	218,750	151.70

Yr	# Ves	# Trip	Tot.Lbs	Lbs/Trip
1975	295	1,664	322,986	194.10
1976	306	1,845	301,071	163.18
1977	377	1,881	323,991	172.24
1978	414	1,268	272,620	215.00
1979	423	2,251	316,132	140.44
1980	461	2,181	372,369	170.73
1981	430	2,481	392,205	158.08
1982	526	2,790	432,259	154.93
1983	541	4,283	484,603	113.15
1984	558	4,272	428,608	100.33
1985	583	4,481	476,457	106.33
1986	538	3,939	476,745	121.03
1987	535	3,920	475,313	121.25
1988	572	4,911	687,379	139.97
1989	537	5,091	634,691	124.67
1990	501	3,242	338,401	104.38
1991	469	2,895	285,046	98.46
1992	407	3,401	329,024	96.74
1993	403	1,977	199,023	100.67
1994	423	2,333	226,436	97.06
1995	400	2,031	194,828	95.93
1996	466	2,780	253,887	91.33
1997	495	3,158	288,107	91.23
1998	480	2,857	257,137	90.00
ave.	281	1,909	295,921	185.44
s.d.	178	1,268	114,587	74.08

Figure 8. Current year and historical catch composition by weight in sold catch.

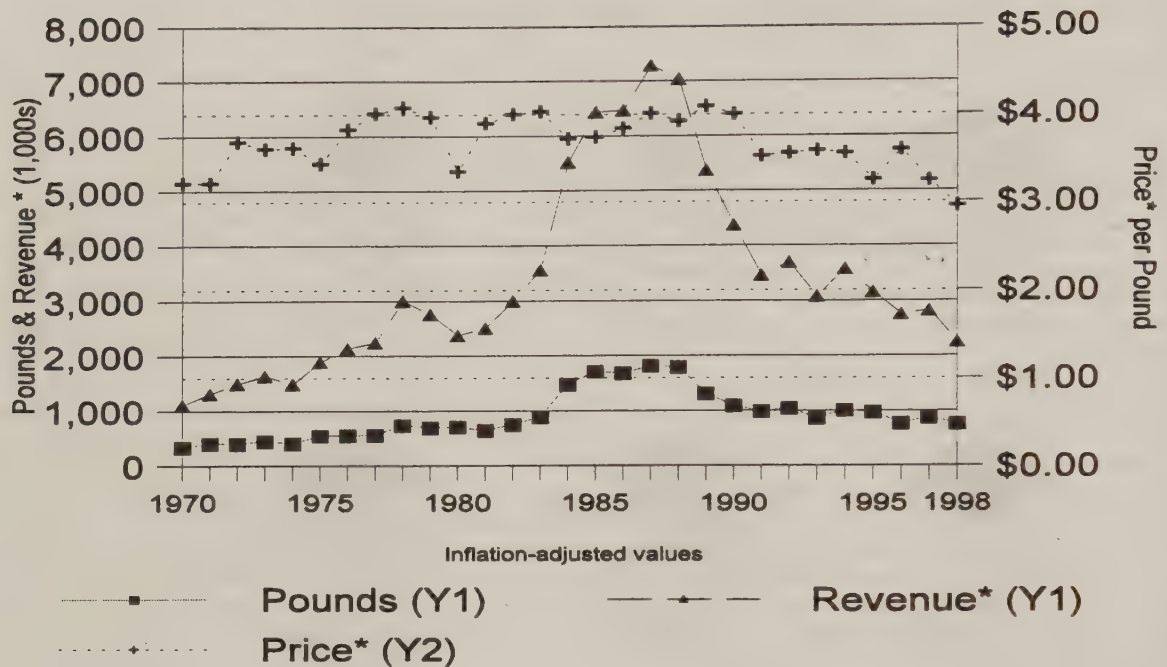


Interpretation: The 1998 pattern closely resembles the historical pattern for the MHI and the Hoomalu zone. In 1998 the Mau zone pattern differs from the historical pattern with uku comprising a much larger component of the catch. This type of pattern with a high uku component occurs frequently (last seen in 1996).

Source: Catch composition estimated from Honolulu auction data.

Comments: Reflects only auction-sold fish, and does not include fish that are kept, given away, or sold at other locations. "Others" in the MHI include butaguchi, gindai, white ulua, lehi, and taape. "Others" in the NWHI include kalekale, gindai, white ulua, lehi, and taape.

Figure 9. Hawaii bottomfish landings, revenues, prices, 1970 - present. (* Inflation-adjusted.)



Interpretation: After almost twenty years of growth, landings and *real* (inflation-adjusted) revenue peaked in 1987 and have declined by 60% and 70%, respectively, in the ten years since then. Inflation-adjusted prices have also declined substantially since the late 1980s and 1990. Previous economic research (mid-1980s) showed a considerable relationship between price and landings, but this relationship appears weaker in the 1990s, perhaps due to increased imports of bottomfish from Pacific island nations. Changes in area and species composition may also be changing the aggregate price (discussed later in the report).

Data: Hawaii Division of Aquatic Resources (HDAR) commercial catch reports are used for all the main Hawaiian Islands (MHI) landings and revenue. HDAR reports are also used for Northwestern Hawaiian Islands (NWHI) landings from 1970-83. NMFS estimates from shoreside monitoring are used for NWHI landings from 1984 - present with more recent years using a combination of HDAR figures and NMFS adjustments.

HDAR data for 1998 are preliminary files, representing approximately 87% of 1997 reports for all gears, all species.

Revenue* represents nominal revenue adjusted for inflation by the Honolulu Consumer Price Index (HCPI); revenue* and prices* are adjusted to the current year.

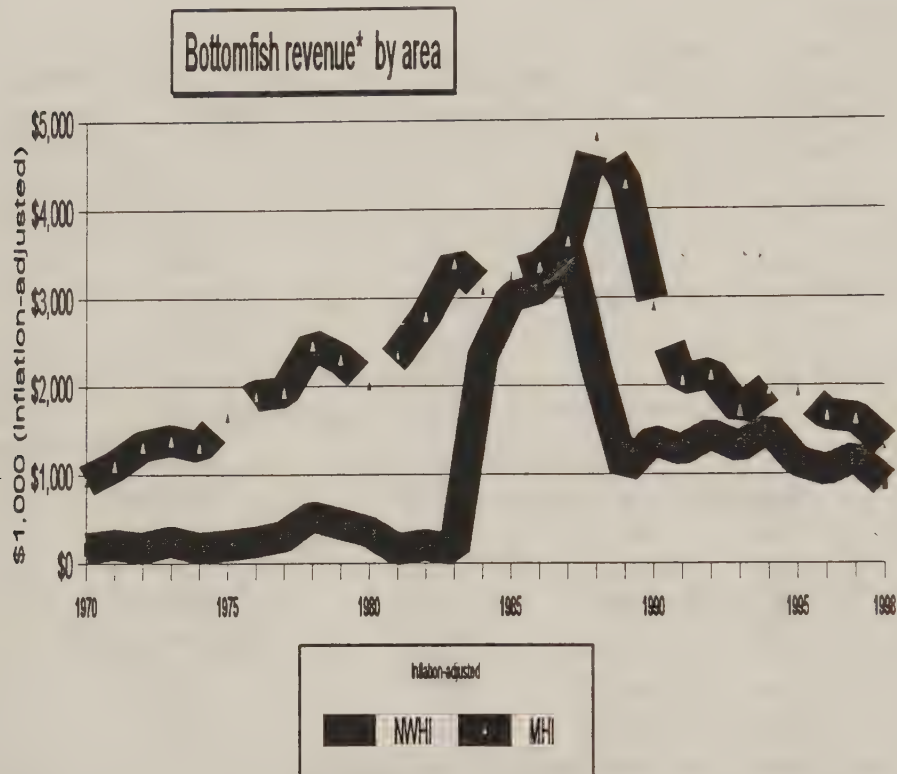
Data source: Data imported from HTOT97a.xls (4/12/99). **Data on following page.**

Hawaii bottomfish landings, revenue, and price, 1970 - present. (* Inflation-adjusted.)

	Pounds All Areas (1,000s)	Revenue All Areas (\$1,000)	Revenue* (Inflation- adjusted)	Price Per Pound (Whole Weight)	Price * (Inflation- adjusted)	HCPI
1970	344	\$253	\$1,115	\$0.73	\$3.22	40.90
1971	410	\$312	\$1,321	\$0.76	\$3.22	42.60
1972	407	\$366	\$1,500	\$0.90	\$3.69	44.00
1973	454	\$418	\$1,642	\$0.92	\$3.61	45.90
1974	413	\$421	\$1,494	\$1.02	\$3.62	50.80
1975	549	\$584	\$1,897	\$1.06	\$3.44	55.50
1976	558	\$693	\$2,143	\$1.24	\$3.83	58.30
1977	562	\$764	\$2,251	\$1.36	\$4.01	61.20
1978	740	\$1,100	\$3,010	\$1.49	\$4.08	65.90
1979	698	\$1,123	\$2,766	\$1.61	\$3.97	73.20
1980	713	\$1,082	\$2,382	\$1.52	\$3.35	81.90
1981	643	\$1,262	\$2,514	\$1.96	\$3.90	90.50
1982	750	\$1,600	\$3,005	\$2.13	\$4.00	96.00
1983	887	\$1,976	\$3,570	\$2.23	\$4.03	99.80
1984	1,481	\$3,192	\$5,518	\$2.15	\$3.72	104.30
1985	1,717	\$3,853	\$6,438	\$2.24	\$3.74	107.90
1986	1,682	\$3,958	\$6,470	\$2.35	\$3.84	110.30
1987	1,819	\$4,687	\$7,291	\$2.58	\$4.01	115.90
1988	1,794	\$4,796	\$7,042	\$2.67	\$3.92	122.80
1989	1,314	\$3,867	\$5,376	\$2.94	\$4.09	129.70
1990	1,094	\$3,371	\$4,376	\$3.08	\$4.00	138.90
1991	984	\$2,864	\$3,468	\$2.91	\$3.52	148.90
1992	1,043	\$3,199	\$3,700	\$3.07	\$3.55	155.90
1993	862	\$2,749	\$3,084	\$3.19	\$3.58	160.70
1994	1,011	\$3,277	\$3,587	\$3.24	\$3.55	164.70
1995	972	\$2,954	\$3,163	\$3.04	\$3.25	168.40
1996	768	\$2,634	\$2,760	\$3.43	\$3.59	172.10
1997	873	\$2,761	\$2,830	\$3.16	\$3.24	175.90
1998 ¹	765	\$2,259	\$2,259	\$2.95	\$2.95	180.30
Average	907	\$2,151	\$3,378	\$2.14	\$3.67	105.63
Standard Deviation	428	\$1,398	\$1,725	\$0.87	\$0.31	45.76

¹ 1998 data are preliminary.

Figure 10. Hawaii bottomfish landings, revenue*, and price* by source, 1970 - present.
 (* Inflation adjusted.)



Interpretation: Inflation-adjusted revenue from main Hawaiian Islands bottomfish grew steadily through the 1970s and 1980s as both *real* prices and total landings increased substantially. Beginning in 1990, total landings began to decline, falling almost 60% in the decade, while inflation-adjusted prices have also declined substantially (perhaps due to the sustained recession of the Hawaii economy). NWHI bottomfish landings grew dramatically in the mid-1980s and then tailed off, stabilizing in the 1990s at a level below the main Hawaiian Islands. Inflation-adjusted revenue is only 25% of the 1987 peak.

These changes in total landings are related to both catch rates and participation, with the number of vessels active in the NWHI bottomfish fishery in 1998 the lowest in several years. More interpretation can be gleaned from discussion in subsequent tables and figures.

Data: Hawaii Division of Aquatic Resources (HDAR) commercial catch reports are used for all the main Hawaiian Islands (MHI) landings and revenue; HDAR reports are also used for Northwestern Hawaiian Islands (NWHI) landings from 1970-83. NMFS estimates from shoreside monitoring are used for NWHI landings from 1984-96. HDAR landings are again used for NWHI landings in 1997.

Revenue* represents nominal revenue adjusted for inflation by the Honolulu Consumer Price Index (HCPI); revenue* and prices* are adjusted to the current year.

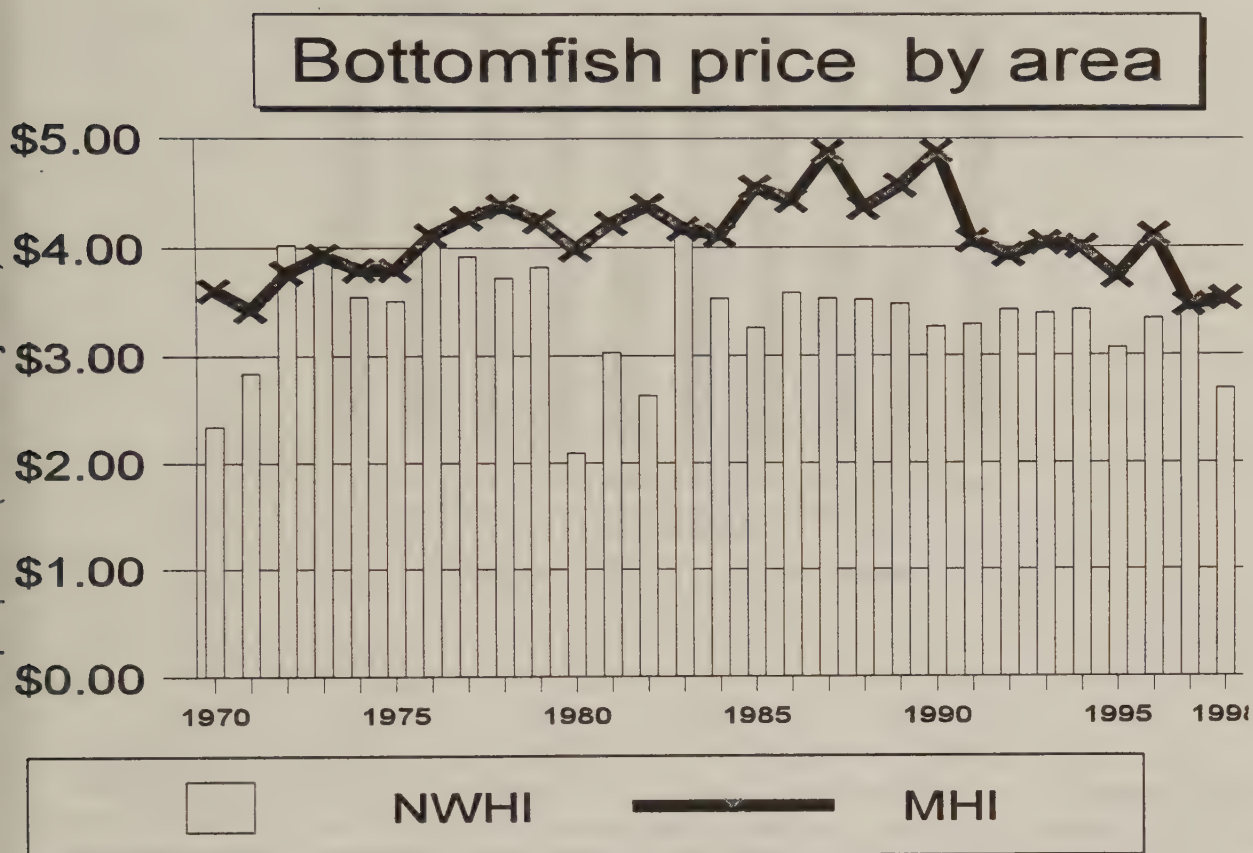
Data source: Data imported from HTOT97a.xls (4/12/99). **Data on following pages.**

Hawaii bottomfish landings, revenue, and price by source, 1970 - present.
 (* Inflation-adjusted.)

	NWHI Pounds	NWHI Revenue	NWHI Revenue* (Inflation-adjusted)	NWHI Aggregate Nominal Price	NWHI Aggregate Price * (Inflation-adjusted)	HCPI
1970	74	\$39	\$172	\$0.53	\$2.34	40.90
1971	75	\$50	\$212	\$0.67	\$2.84	42.60
1972	43	\$42	\$172	\$0.98	\$4.02	44.00
1973	62	\$63	\$247	\$1.02	\$4.01	45.90
1974	49	\$49	\$174	\$1.00	\$3.55	50.80
1975	59	\$64	\$208	\$1.08	\$3.51	55.50
1976	59	\$78	\$241	\$1.32	\$4.08	58.30
1977	83	\$104	\$306	\$1.33	\$3.92	61.20
1978	143	\$194	\$531	\$1.36	\$3.72	65.90
1979	118	\$183	\$451	\$1.55	\$3.82	73.20
1980	172	\$163	\$359	\$0.95	\$2.09	81.90
1981	52	\$79	\$157	\$1.52	\$3.03	90.50
1982	77	\$108	\$203	\$1.40	\$2.63	96.00
1983	38	\$89	\$161	\$2.34	\$4.23	99.80
1984	661	\$1,350	\$2,334	\$2.04	\$3.53	104.30
1985	922	\$1,800	\$3,008	\$1.95	\$3.26	107.90
1986	869	\$1,900	\$3,106	\$2.19	\$3.58	110.30
1987	1015	\$2,300	\$3,578	\$2.27	\$3.53	115.90
1988	625	\$1,500	\$2,202	\$2.40	\$3.52	122.80
1989	303	\$756	\$1,051	\$2.50	\$3.48	129.70
1990	423	\$1,066	\$1,384	\$2.52	\$3.27	138.90
1991	387	\$1,053	\$1,275	\$2.72	\$3.29	148.90
1992	424	\$1,255	\$1,451	\$2.96	\$3.42	155.90
1993	385	\$1,164	\$1,306	\$3.02	\$3.39	160.70
1994	443	\$1,382	\$1,513	\$3.12	\$3.42	164.70
1995	369	\$1,060	\$1,135	\$2.87	\$3.07	168.40
1996	311	\$993	\$1,040	\$3.19	\$3.34	172.10
1997	346	\$1,152	\$1,181	\$3.33	\$3.41	175.90
1998	332	\$894	\$894	\$2.69	\$2.69	180.30
Average	308	\$722	\$1,036	\$1.96	\$3.38	105.63
Standard Deviation	278	\$674	\$966	\$0.83	\$0.50	45.76

	MHI Pounds	MHI Revenue	MHI Revenue* (Inflation -adjusted)	MHI Aggregate Price	MHI Aggregate Price * (Inflation -adjusted)	HCPI
1970	270	\$214	\$943	\$0.82	\$3.61	40.90
1971	335	\$262	\$1,109	\$0.81	\$3.43	42.60
1972	364	\$324	\$1,328	\$0.92	\$3.77	44.00
1973	392	\$355	\$1,394	\$1.00	\$3.93	45.90
1974	364	\$372	\$1,320	\$1.07	\$3.80	50.80
1975	485	\$513	\$1,667	\$1.17	\$3.80	55.50
1976	499	\$615	\$1,902	\$1.33	\$4.11	58.30
1977	479	\$660	\$1,944	\$1.45	\$4.27	61.20
1978	597	\$906	\$2,479	\$1.60	\$4.38	65.90
1979	580	\$940	\$2,315	\$1.72	\$4.24	73.20
1980	541	\$919	\$2,023	\$1.81	\$3.98	81.90
1981	591	\$1,183	\$2,357	\$2.12	\$4.22	90.50
1982	673	\$1,492	\$2,802	\$2.33	\$4.38	96.00
1983	847	\$1,882	\$3,400	\$2.31	\$4.17	99.80
1984	803	\$1,797	\$3,106	\$2.38	\$4.11	104.30
1985	765	\$1,954	\$3,265	\$2.72	\$4.55	107.90
1986	811	\$2,052	\$3,354	\$2.71	\$4.43	110.30
1987	785	\$2,345	\$3,648	\$3.14	\$4.88	115.90
1988	1,166	\$3,288	\$4,828	\$2.97	\$4.36	122.80
1989	1,007	\$3,090	\$4,296	\$3.29	\$4.57	129.70
1990	651	\$2,242	\$2,910	\$3.76	\$4.88	138.90
1991	562	\$1,713	\$2,074	\$3.35	\$4.06	148.90
1992	588	\$1,842	\$2,130	\$3.40	\$3.93	155.90
1993	462	\$1,535	\$1,722	\$3.60	\$4.04	160.70
1994	536	\$1,793	\$1,963	\$3.65	\$4.00	164.70
1995	570	\$1,818	\$1,946	\$3.48	\$3.73	168.40
1996	442	\$1,593	\$1,669	\$3.92	\$4.11	172.10
1997	519	\$1,589	\$1,629	\$3.39	\$3.47	175.90
1998	424	\$1,336	\$1,336	\$3.52	\$3.52	180.30
Average	590	\$1,401	\$2,306	\$2.40	\$4.09	105.63
Standard Deviation	200	\$800	\$946	\$1.02	\$0.37	45.76

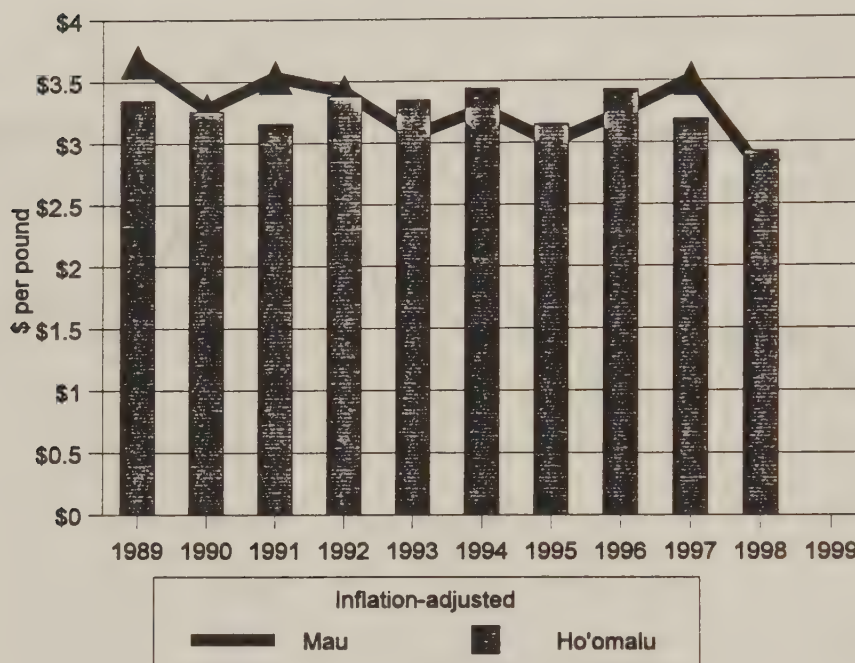
Figure 11. Hawaii bottomfish ex-vessel prices by source, 1987 - present.
(Price* adjusted for inflation.)



Interpretation: Historically, bottomfish caught in the main Hawaiian Islands have tended to have higher aggregate prices, reflecting both species composition and greater freshness. However, in the late 1990s, the prices appeared to converge. This might have reflected a relative lowering of the MHI bottomfish prices, perhaps reflecting the softness of the upscale part of the Hawaii market. However in 1998, prices again diverged. The percentage of the three highest valued species (ehu, onaga, and opakapaka) in total landings declined by 4% in the NWHI in 1998 (compared to 1997), while the proportion remained stable for 1997. However, on a species-by-species comparison, it is more difficult to interpret. For example, 1998 opakapaka prices rose in the NWHI while they fell in the MHI. On the other hand, onaga prices fell in both locations.

Data: See Figure 10.

Figure 12. Hawaii Bottomfish Ex-vessel Prices by NWHI zone, 1989 - present.
(* Inflation-adjusted.)



Interpretation: Because of the substantial increase in Mau zone prices in 1997 (delineated by the line in the chart), bottomfish prices for the two zones have become effectively the same over time, although the Ho'omalau zone had a higher percentage of the three top-priced species (ehu, onaga, and opakapaka). In 1998 aggregate prices declined, presumably due to a soft market.

Hawaii Bottomfish Ex-vessel Prices by NWHI zone, 1989 - present.
(Inflation-adjusted prices to current year base)

Year	Nominal Price per Pound		Inflation-adjusted Price		
	Mau	Ho'omalulu	Mau	Ho'omalulu	HCPI
1989	\$2.64	\$2.41	\$3.67	\$3.35	129.70
1990	\$2.53	\$2.51	\$3.28	\$3.26	138.90
1991	\$2.92	\$2.61	\$3.54	\$3.16	148.90
1992	\$2.96	\$2.92	\$3.42	\$3.38	155.90
1993	\$2.73	\$2.99	\$3.06	\$3.35	160.70
1994	\$3.00	\$3.14	\$3.28	\$3.44	164.70
1995	\$2.80	\$2.94	\$3.00	\$3.15	168.40
1996	\$3.09	\$3.27	\$3.24	\$3.43	172.10
1997	\$3.42	\$3.11	\$3.51	\$3.19	175.90
1998	\$2.77	\$2.93	\$2.77	\$2.93	180.30
Average	\$2.89	\$2.88	\$3.28	\$3.26	159.55
Standard Deviation	\$0.25	\$0.28	\$0.27	\$0.16	16.35

Data: NWHI prices are compiled from NMFS market monitoring. Inflation-adjusted values are to current year base HCPI (Honolulu Consumer Price Index).

Data source: nwhi98a.xls (10/7/98); updated from raw data (4/16/99)

Table 1. Hawaii bottomfish species landings and prices, 1997 & 1998.²

	1997			1998		
	Average Price	Pounds	Revenue	Average Price	Pounds	Revenue
Butaguchi	\$1.50	57,277	\$85,578	\$1.38	39,911	\$55,060
Ehu	\$3.63	42,399	\$153,812	\$3.36	38,392	\$128,976
Hapuupuu	\$3.07	72,868	\$223,536	\$2.50	82,502	\$206,189
Onaga	\$5.24	124,361	\$652,043	\$4.77	96,623	\$460,471
Opakapaka	\$4.35	258,309	\$1,123,080	\$4.26	220,637	\$940,071
Uku	\$2.88	105,378	\$302,994	\$2.74	120,397	\$329,533
Ulua	\$0.98	8,400	\$8,198	\$1.30	9,312	\$12,139
Other BMUS	\$1.39	148,928	\$206,844	\$1.36	114,390	\$156,060
Other Bottomfish	\$1.82	54,453	\$99,039	\$1.80	42,946	\$77,364
Total Bottomfish	\$3.27	872,373	\$2,855,124	\$3.09	765,110	\$2,365,863

Interpretation: Species prices show the significance of species composition in aggregate statistics. Aggregate bottomfish landings (all species combined from both areas) declined by 12% in 1998, with prices for the major species such as ehu and onaga falling by about that percentage, while hapuupuu prices fell by almost 20% but opakapka prices falling hardly at all. Since landings were lower in 1998, it would appear that the continuing recession in the tourism industry is affecting the market for restaurant grade snappers, groupers, and jacks. However, there was also a substantial increase in imports (as recorded by U.S. Customs³), with 440,000 pounds of snapper (\$1.2 million) recorded in 1998, compared to 256,000 pounds in 1997 (\$1.2 million), and 160,000 pounds (\$288,000) in 1995. It would appear that fully one-third of the market is now filled by imports. (Most of these imports were from Tonga.)

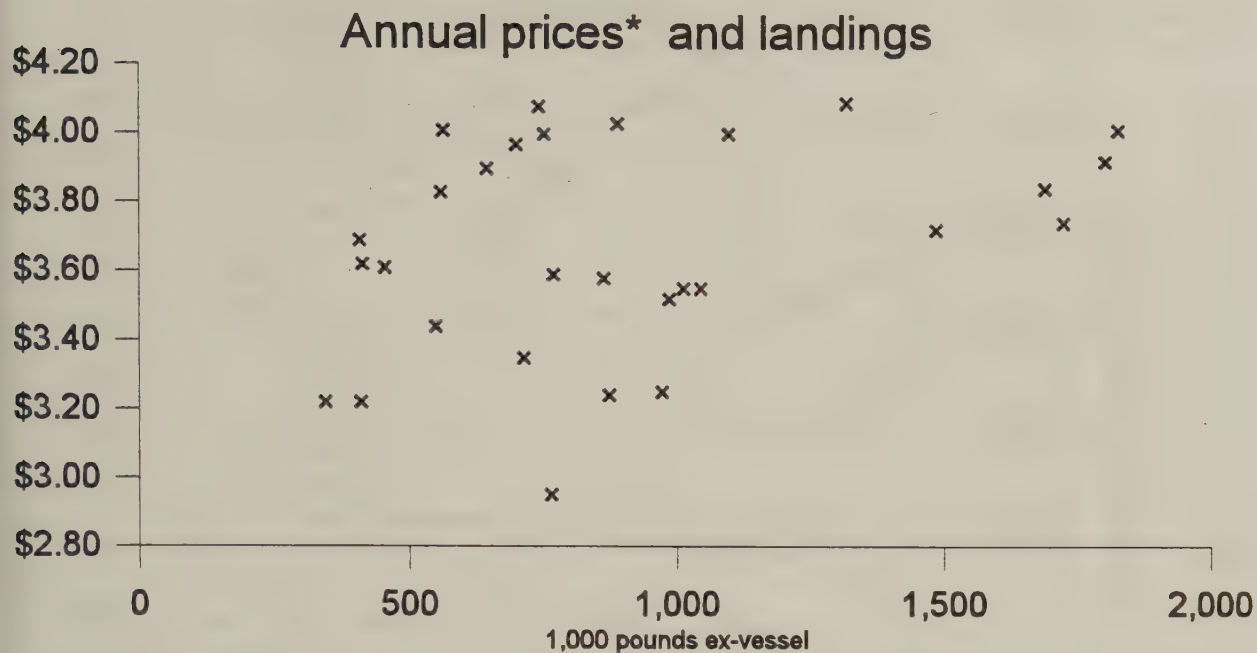
Data & Data Sources: Hawaii Division of Aquatic Resources (HDAR) commercial catch reports are used for all the main Hawaiian Islands (MHI) landings and revenue; HDAR reports are also used for Northwestern Hawaiian Islands (NWHI) landings from 1970-83. NMFS estimates from shoreside monitoring are used for NWHI landings from 1984-96. HDAR landings are again used for NWHI landings in 1997.

Data imported from: B8798N.xls (4/12/99)

² Small differences may exist between species totals and area totals due to rounding.

³ Species identification in the Customs data may be suspect, since a substantial proportion of imports are undifferentiated "fish."

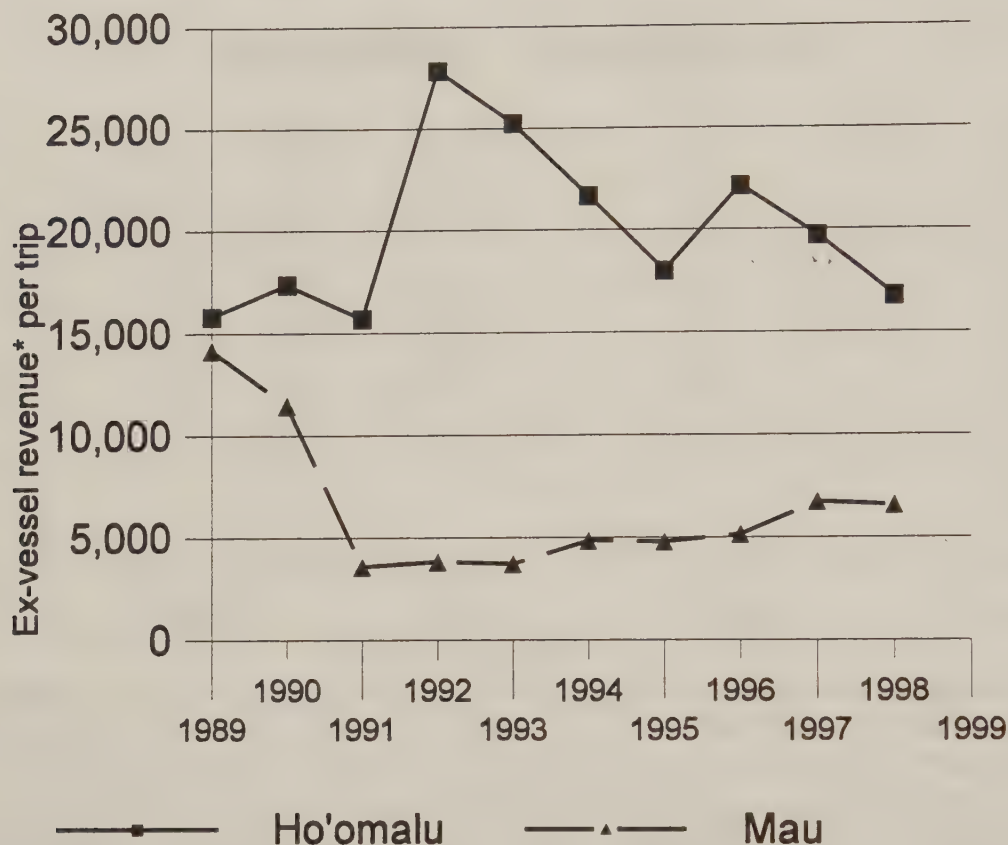
Figure 13. Hawaii bottomfish demand (annual, inflation-adjusted ex-vessel price* and total domestic landings, 1970 - present.)



Interpretation: Economic research in the mid-1980s showed a considerable (negative) relationship between weekly bottomfish landings and ex-vessel price. However this relationship is not shown for the annual data. As shown by this and the earlier figure, despite a considerable decrease in total landings, inflation-adjusted ex-vessel price has been quite stable over the past 30 years. The impact of imports may be significant. In 1997 imported snapper and grouper prices were higher than aggregate local prices, although they were lower in 1998.

Data: See Figure 9.

Figure 14. NWHI bottomfish inflation-adjusted revenue* per trip by zone, 1989 - present.



Interpretation: The two trends in inflation-adjusted revenue per trip show the distinct difference between Ho'omalau and Mau zone operations. When the limited entry provisions began to take effect in the Ho'omalau zone in 1989-91, revenue rose dramatically while revenue in the Mau zone fell (as the limited entry vessels could no longer fish in the Mau zone). After that initial drop, however, revenue per trip in the Mau zone has been quite stable. The Ho'omalau zone has shown more variability but has had a downward trend since 1992.

NWHI bottomfish inflation-adjusted revenue* per trip by zone, 1989 - present.

Year	Ho'omalū Zone			Mau Zone		
	Revenue* \$1,000	Trips	Revenue* per Trip	Revenue* \$1,000	Trips	Revenue* per Trip
1989	443	28	15,832	312	22	14,179
1990	435	25	17,387	631	55	11,470
1991	739	47	15,717	301	84	3,583
1992	1,031	37	27,861	210	55	3,821
1993	859	34	25,266	268	72	3,722
1994	889	41	21,685	479	99	4,843
1995	594	33	18,006	465	97	4,791
1996	576	26	22,154	417	81	5,148
1997	750	38	19,729	357	53	6,736
1998	839	50	16,772	257	39	6,579
Average	715	36	20,041	370	66	6,487
Standard Deviation	198.4	8.5	4,136.7	128.4	25.2	3,568.8

Data: Data are compiled from NMFS shoreside market monitoring for 1984-95 and then combined with HDAR data for 1996 and 1997. Revenue is adjusted for inflation to the current base year by the Honolulu consumer price index.

Data Source: Imported from NWHI98a.xls (4/16/99)

Table 2. Ho'omalū zone bottomfish vessel, income statement, 1998.

Income Statement– NWHI Bottomfish Vessel Ho'omalū zone, 1998 average			
Revenue			\$126,477
Fixed Costs			\$73,487
	Capital	\$18,512	
	Annual Repair	\$13,015	
	Vessel Insurance	\$32,312	
	Administrative	\$7,629	
	Other	\$2,019	
Operating Costs			\$103,395
	Fuel & Oil	\$12,678	
	Ice	\$2,693	
	Bait	\$6,171	
	Handling	\$12,600	
	Provisions	\$8,415	
	Gear and Supplies	\$9,985	
	Other (trip basis)	\$12,454	
	Crew's income	\$24,000	
	Captain's income	\$14,400	
	<i>Net on Operations</i>	\$23,082	
Total Cost			\$176,882
Net Revenue			\$-50,405

Data source: nwhb98h1.xls (4/16/99)

Table 3. NWHI Ho'omalū zone bottomfish vessel economics, operating characteristics

**Operating characteristics –
Ho'omalū zone bottomfish vessel, 1998**

Investment	\$233,300	
Trips	7.14	
Trip Days: Total & Trip	166	23.18
Fishing Days: Total & Trip	72	10.10
Catch per Day (Lbs): Total	606	
Bottomfish & Other	587	19
Total Catch (Whole lbs)	43,698	
Bottomfish & Other	42,351	1,347
Price per Pound	\$2.89	
Bottomfish & Other	\$2.93	\$1.80
Unallocated trip days	134	
HCPI (1993 base)	1.12	
Fixed Cost rate	1.00	

Interpretation: As in previous years, the average⁴ Ho'omalū zone bottomfish fishing vessel failed to cover its total costs through bottomfishing operations in 1998. There was a positive return on operations (Total ex-vessel revenue minus operating costs) of \$23,000; presumably other fishing activities or sources of income had to be employed to cover fixed costs (\$73,000).⁵

Data: Cost-earnings information was compiled by Hamilton in 1994, and updated to account for inflation and to reflect current operating characteristics.

Data Source: nwhb98h1.xls (4/16/99)

⁴ Recalling that in every *average*, some vessels do better, some not as well.

⁵ Fixed costs can be covered as well by deferred maintenance, reducing insurance, etc. To the extent that these measures are being taken, they reduce the economic value of the investment.

Table 4. Mau zone bottomfish vessel, income statement, 1998.

Income Statement-- NWHI Bottomfish Vessel Mau Zone, 1998 Average			
Revenue			\$36,651
Fixed Costs			\$12,594
	Capital	\$3,875	
	Annual Repair	\$4,583	
	Vessel Insurance	\$2,683	
	Administrative	\$1,453	
	Other	\$0	
Operating Costs			\$31,290
	Fuel & Oil	\$3,927	
	Ice	\$1,010	
	Bait	\$1,459	
	Handling	\$3,700	
	Provisions	\$1,571	
	Gear and Supplies	\$2,244	
	Other (trip basis)	\$2,580	
	Crew's income	\$6,100	
	Captain's income	\$8,700	
	<i>Net on Operations</i>	<i>\$5,361</i>	
Total Cost			\$43,884
Net Revenue			(\$7,233)

Data Source: nwhb98h1.xls (4/16/99)

Table 5. NWHI Mau zone bottomfish vessel economics, 1998

Operating characteristics— Mau zone bottomfish vessel, 1998		
Investment	\$157,072	
Trips	5.57	
Trip Days: Total & Trip	50	8.92
Fishing Days: Total & Trip	26	4.64
Catch per Day (Lbs): Total	513	
Bottomfish & Other	365	148
Catch per Trip: Total	2,381	
Bottomfish & Other	1,694	687
Total Catch (Whole lbs)	13,265	
Bottomfish & Other	9,438	3,827
Price per Pound	\$2.77	
Bottomfish & Other	\$3.04	\$2.09
Unallocated trip days	257	

Interpretation: Mau zone vessels also failed to cover their costs in 1998, although less of their total operations are (on average) reliant on bottomfish fishing. A more substantial analysis was conducted for the proposed limited entry schema.

Data: Cost-earnings information was compiled by Hamilton in 1994, and updated to account for inflation and to reflect current operating characteristics.

Data Source: nwhb98h1.xls (4/16/99)

Table 6. NWHI “optimality” scenarios for NWHI bottomfish vessels, 1998.

This table presents current results using the methodology of the Ho’omaluku zone limited entry amendment to determine the “optimal” number of vessels for each zone in the Northwestern Hawaiian Islands. Three optimality criteria are utilized: 1) assuming vessels achieve the MSY catch rate; 2) assuming that vessels operate at FTE levels (full-year operations); and 3) assuming that vessels break-even on average.

The “optimality” methodology divides the MSY level of total catch for each zone (131,210 pounds for the Mau zone and 455,290 for the Ho’omaluku zone) by the annual catch per vessel under the three criteria. This determines the “optimal” number of vessels.

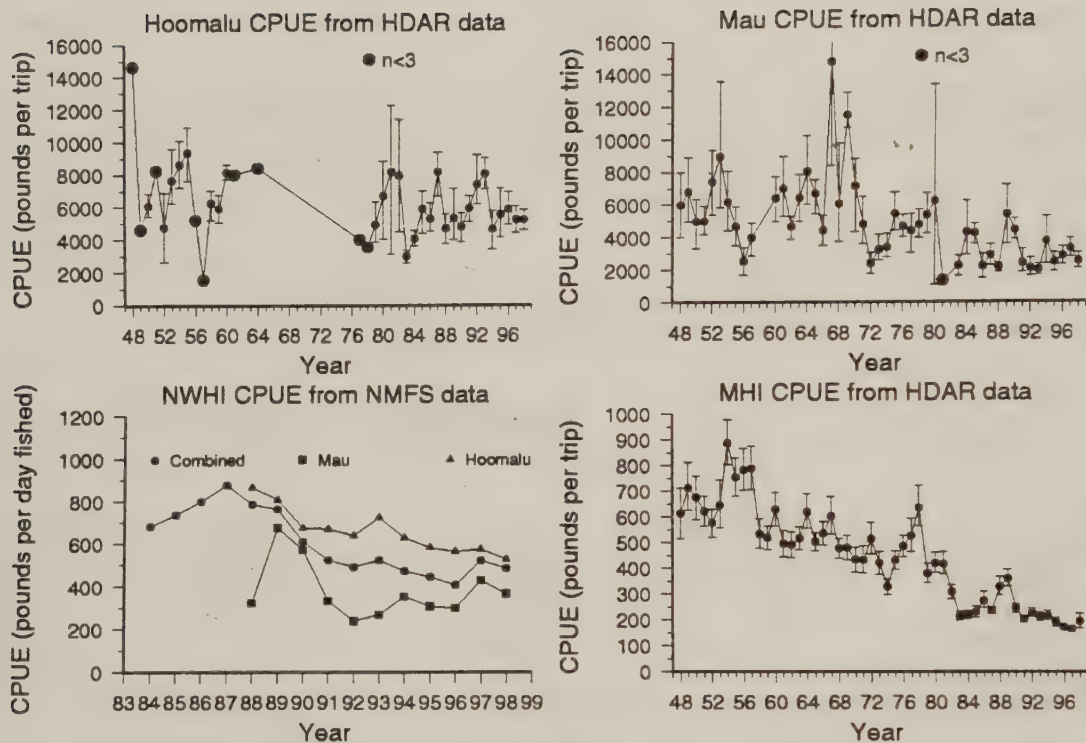
NWHI Bottomfish MSY economic analysis 1998 operating basis			
	NWHI Combined	Mau	Ho’omaluku
Maximum Sustainable Yield (MSY)	586,490	131,210	455,290
% MSY by zone	100.0%	22.4%	77.6%
1998 actual catch	345,547	68,765	276,782
% of zone’s MSY	58.9%	52.4%	60.8%

Catch & operating levels	Number of Vessels		
	Combined NWHI	Mau	Ho'omalu
1998 Actual	14	7	7
Current year CPUE	26	14	12
MSY CPUE	25	15	10
MSY CPUE at FTE	9	3	6
Breakeven CPUE at FTE	7	3	4
NWHI Combined* -- based on unweighted average vessel characteristics			
	Bottomfish catch per vessel (pounds)		
	NWHI Combined	Mau	Ho'omalu
Current year CPUE	23,711	9,425	37,997
MSY CPUE	27,304	8,869	45,739
MSY CPUE at FTE	57,120	38,314	75,926
Breakeven CPUE at FTE	73,066	44,458	101,674

Interpretation: Under the limited access program's criteria for the Ho'omalu zone, the "optimal" number of vessels -- using full-time equivalent vessels at MSY cpue -- is 4, which exceeds the current number due to the new entrants in 1998. Under the Limited Entry FMP, this kind of ebb and flow in the fishery is to be expected. However, no new vessels can be admitted into the Ho'omalu zone until the current number is less than the "optimal" number of vessels for the zone. Evaluation of the conservation standard for the Ho'omalu zone remains important since the number of potentially active vessels exceeds the limited access program's entry standard.

As for the Mau zone, where limited entry rules are being developed, the number of active vessels exceeds the standard based on the Ho'omalu zone rules. However, the Mau zone task force developed a different standard, based on the MSY cpue only. Under this standard, the "optimal" number of vessels is 15 which exceeds the current number of active vessels.

Figure 15a. CPUE for Hawaiian bottomfish



Interpretation: Decreases in MHI CPUE to about 25% of early CPUE values signify a strong yellow light condition for the fishery in this area. The increase in the late 1980's MHI CPUE was due primarily to a large increase in uku catches alone and may not indicate an increase in abundance of other species. Rapid decreases in CPUE from the 1989-90 highs may be a return to the prevailing slow decline. The reasons for differing trends in CPUE values for the Hoomalu Zone with differing data sources are unclear, though they could be due to shorter trips with higher CPUE on a per day basis or a change in fleet composition with the new entrants.

Comments: 1998 values for CPUE using the HDAR data set are well below their long-term averages for all three fishing zones with that for the MHI being only about 43% and the Mau zone 36% of their long-term averages.

There is a long-term decreasing trend in MHI CPUE, with current values approximately 25% that of the initial estimate. The 1998 MHI CPUE value shows an increase over 1996 and 1997 values, but the four values from 1995-1998 are still the lowest values on record. MHI trips are assumed to be one day in length, so CPUE values presented here reflect catch per day as well as catch per trip.

catch per trip.

The NMFS vessel interview NWHI CPUE for 1998 for the Mau Zone is lower than the 1997 value, but still higher than any other value since 1990. The 1998 NMFS CPUE value decreased slightly for the Hoomalu Zone, as well. The 1998 HDAR CPUE values (CPUE/trip) show similar decreases in CPUE for both the Mau and the Hoomalu zones. The HDAR CPUE is used for NWHI SPR calculations because it is a longer time series and may better estimate virgin fishery catch rates. There are no correction factors for possible changes in trip duration or fleet composition.

Source: MHI CPUE is based on HDAR C-3 catch report data from commercial fishermen. Two NWHI CPUE's are presented, one based on the NMFS vessel interview program catch data, and one based on HDAR C-3 catch report data from commercial fishermen.

Calculation & Adjustment: MHI trips were screened to only include trips from the areas of Maui, Lanai, Molokai, and Penguin Banks that had at least 90% of the catch by weight in bottomfish. Additionally, some MHI small boats were excluded based on minimum annual landings criteria to correct for temporal changes in the fleet composition (licensees must land at least 30% of the median value of the top ten producers to qualify). The NMFS vessel interview data prior to 1988 does not allow separate Mau and Hoomalu CPUE calculations; therefore, the combined area NWHI CPUE is presented as well. The NWHI HDAR CPUE used data screened to only include trips where at least 90% of the catch by weight was bottomfish and at least 1000 pounds of bottomfish were caught. All catch data reported by the same licensee on consecutive days were collapsed to a trip summary, since 1) most other reports are apparent multi-day trip summaries, and 2) consecutive day reporting may be reflective of marketing rather than fishing activity. There was an apparent absence of Hoomalu Zone trips from the mid-1960's until the late-1970's. The 95% non-parametric confidence intervals for the HDAR CPUE's were calculated by bootstrapping.

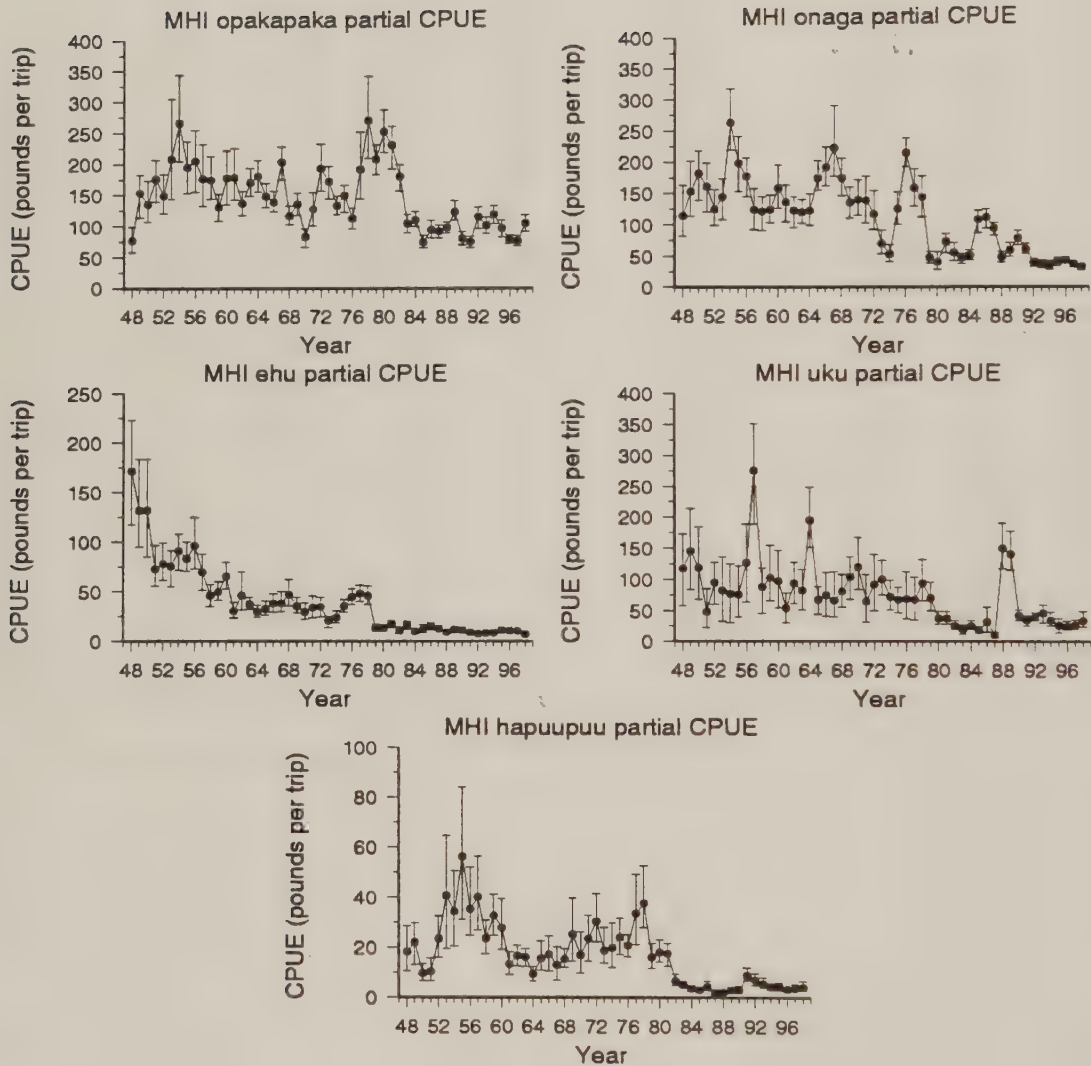
Figure 15a data summaries:

Year	Pounds/Trip		
	MHI	Mau	Hoomalu
1948	614	5968	14635
1949	713	6799	4614
1950	677	4966	6072
1951	621	4980	8228
1952	577	7407	4766
1953	645	8937	7627
1954	887	6158	8613
1955	755	4659	9336
1956	784	2523	5202
1957	789	3958	1535
1958	533	NA	6254
1959	519	NA	5897
1960	630	6379	8139
1961	496	6999	7978
1962	491	4641	NA
1963	518	6410	NA
1964	619	8028	8390
1965	503	6656	NA
1966	536	4413	NA
1967	602	14749	NA
1968	478	6055	NA
1969	480	11484	NA
1970	433	7111	NA
1971	433	4784	NA
1972	514	2386	NA
1973	421	3224	NA
1974	329	3367	NA

Year	Pounds/Trip		
	MHI	Mau	Hoomalu
1975	430	5439	NA
1976	485	4653	NA
1977	527	4387	4000
1978	635	4753	3550
1979	380	5361	4951
1980	421	6210	6687
1981	416	1336	8167
1982	307	NA	7953
1983	214	2242	3025
1984	220	4308	4085
1985	230	4239	5909
1986	274	2206	5301
1987	237	2889	8187
1988	329	2136	4702
1989	361	5412	5328
1990	245	4454	4793
1991	202	2413	5928
1992	228	2092	7388
1993	213	1992	8040
1994	218	3748	4651
1995	193	2460	5544
1996	172	2823	5870
1997	164	3294	5234
1998	194	2518	5198
Average	448.86	4867.88	6268.05
Std.Dev	187.41	2546.14	2275.52

Year	NMFS NWHI CPUE (lb/day)		
	Mau	Hoomalu	Combined
1984	NA	NA	682
1985	NA	NA	736
1986	NA	NA	800
1987	NA	NA	877
1988	322	866	786
1989	677	808	763
1990	573	675	611
1991	333	671	525
1992	239	639	491
1993	267	723	523
1994	353	629	526
1995	306	582	442
1996	298	563	407
1997	429	574	521
1998	364	527	484
Average	379.70	673.00	625.36
Standard Dev.	141.03	100.70	144.31

Figure 15b. Partial CPUE for MHI bottomfish



Year	MHI Partial CPUE (lb/trip)				
	OPA	ONA	EHU	UKU	HAP
1948	77	115	172	117	18
1949	153	153	132	146	22
1950	135	182	132	119	10
1951	176	161	73	48	11
1952	149	124	78	95	24
1953	208	144	76	82	41
1954	266	262	91	77	35
1955	195	198	83	76	56
1956	204	177	97	127	36
1957	176	124	70	275	40
1958	174	121	47	88	24
1959	130	124	50	103	33
1960	177	158	66	97	28
1961	178	136	31	54	13
1962	136	123	47	94	17
1963	169	120	38	82	16
1964	180	122	30	195	9
1965	148	174	33	67	16
1966	138	191	38	75	17
1967	203	222	39	66	13
1968	116	174	47	81	15
1969	135	135	35	104	25
1970	83	140	30	120	17
1971	127	138	34	65	24
1972	192	116	35	92	31
1973	171	70	21	101	19
1974	132	52	24	72	20
1975	149	124	36	68	24
1976	112	214	45	69	21
1977	191	158	49	67	34
1978	269	143	46	94	38
1979	207	47	13	70	16
1980	251	40	13	37	18
1981	229	72	18	37	18
1982	179	55	11	25	7
1983	104	46	17	20	5
1984	109	51	10	26	4
1985	74	107	12	18	3
1986	93	111	15	31	5
1987	91	93	13	10	2
1988	97	48	9	150	2
1989	122	59	12	140	3
1990	80	77	12	42	3
1991	75	60	9	34	9
1992	115	39	8	39	7
1993	100	37	9	46	6
1994	118	34	9	34	4
1995	96	40	11	26	5
1996	77	43	11	24	3
1997	76	36	11	27	4
1998	104	32	7	33	4
Average	146.52	113.66	40.90	77.04	17.42
Standard Dev.	52.15	57.49	36.24	49.02	12.51

Interpretation: Reduction of species-specific CPUE for species presented here, with the exception of opakapaka, to less than half of their early values would suggest a yellow light situation for all of these species, especially ehu and onaga. Caution must be used in this interpretation because factors such as targeting of effort to specific species is not taken into account (see next section for targeted effort).

Comments: All CPUE time series remain highly variable. All 1998 partial CPUE values are well below their long-term averages. There are apparent declines in most species when comparing several years of recent values with values earlier in the time series. The decline is least apparent in opakapaka and most apparent in ehu. MHI trips are usually of one day duration.

Source: The partial CPUE for the MHI is based on HDAR C-3 catch report data from commercial fishermen.

Calculation & Adjustment: The same subset of HDAR data as used in Fig. 15a is used here, but the weight of each species is tabulated separately rather than in aggregate. The same denominator value used in Fig. 15a is used here (# trips fished), i.e. summing these five partial CPUE's (and remaining BMUS CPUE's) will approximate the Fig. 15a estimates. 95% non-parametric confidence intervals were calculated by bootstrapping.

Figure 15c. Partial targeted CPUE for MHI bottomfish

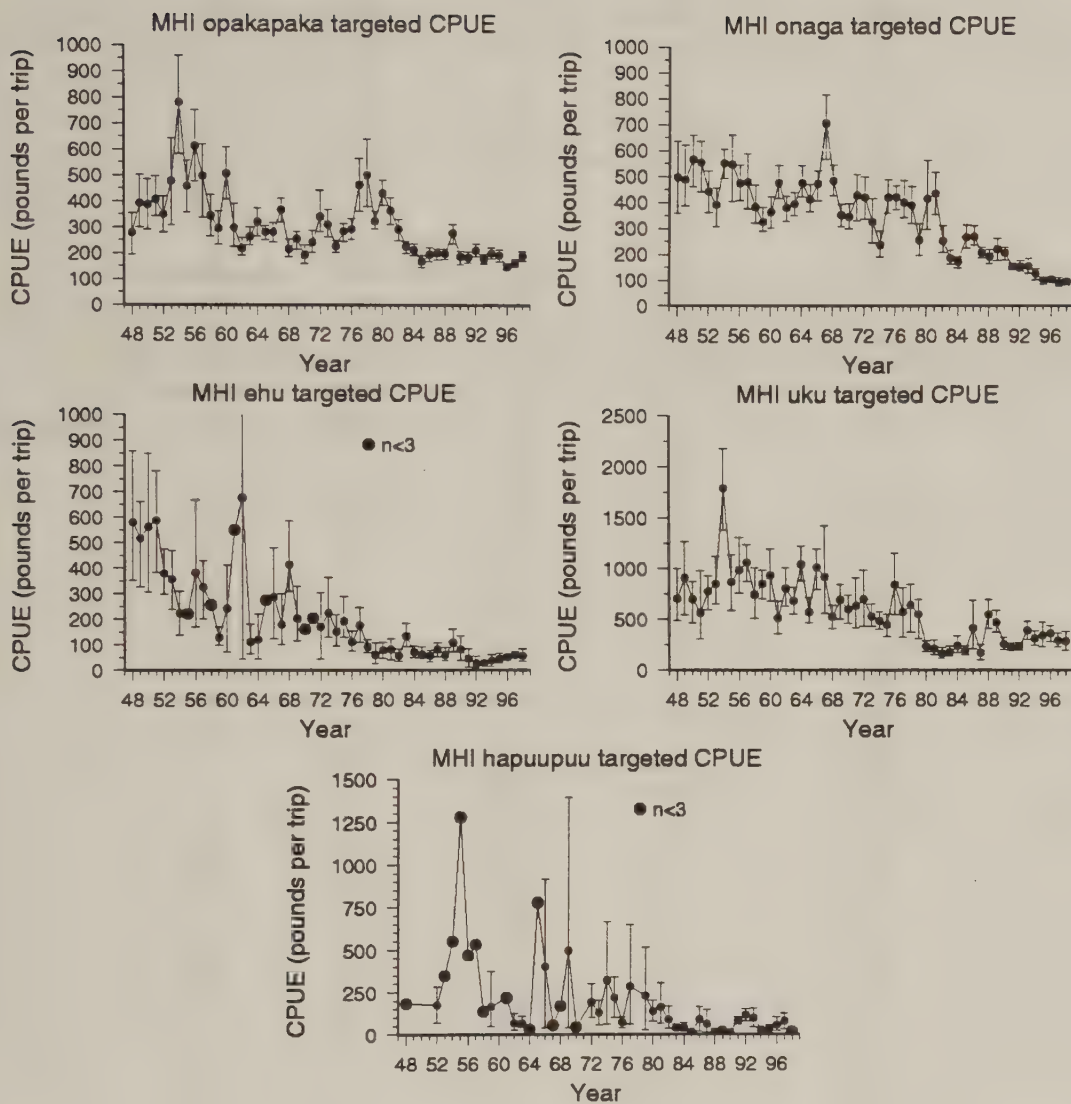


Figure 15c data summary:

Year	MHI Targeted CPUE (lb/Trip)			
	Opakapaka	Onaga	Ehu	Uku
1948	277	496	581	705
1949	391	488	517	913
1950	385	566	564	701
1951	406	554	589	567
1952	348	442	380	779
1953	476	390	358	850
1954	779	552	224	1796
1955	458	547	222	869
1956	613	473	384	988
1957	496	479	327	1061
1958	344	382	257	745
1959	293	325	130	852
1960	507	364	242	939
1961	297	476	550	514
1962	216	379	677	806
1963	263	394	111	683
1964	320	475	120	1046
1965	281	411	275	574
1966	280	472	288	1014
1967	366	706	180	919
1968	215	484	415	525
1969	254	353	203	696
1970	191	345	161	600
1971	241	428	205	634
1972	339	420	171	699
1973	309	324	226	531
1974	225	236	152	488
1975	284	419	194	448
1976	293	421	112	846
1977	462	400	178	573
1978	501	389	92	640
1979	323	255	61	552
1980	430	415	79	235
1981	364	433	83	212
1982	293	252	58	164
1983	225	186	135	179
1984	212	173	72	241
1985	168	266	63	193
1986	194	267	58	418
1987	199	206	82	175
1988	198	192	60	549
1989	278	221	109	468
1990	187	205	82	260
1991	183	153	45	224
1992	212	154	27	238
1993	176	155	28	393
1994	200	125	37	311
1995	191	100	45	343
1996	147	103	51	363
1997	162	89	61	292
1998	190	93	57	286
Average	308.52	350.54	206.12	595.78
Std. Dev.	126.60	145.53	172.54	315.10

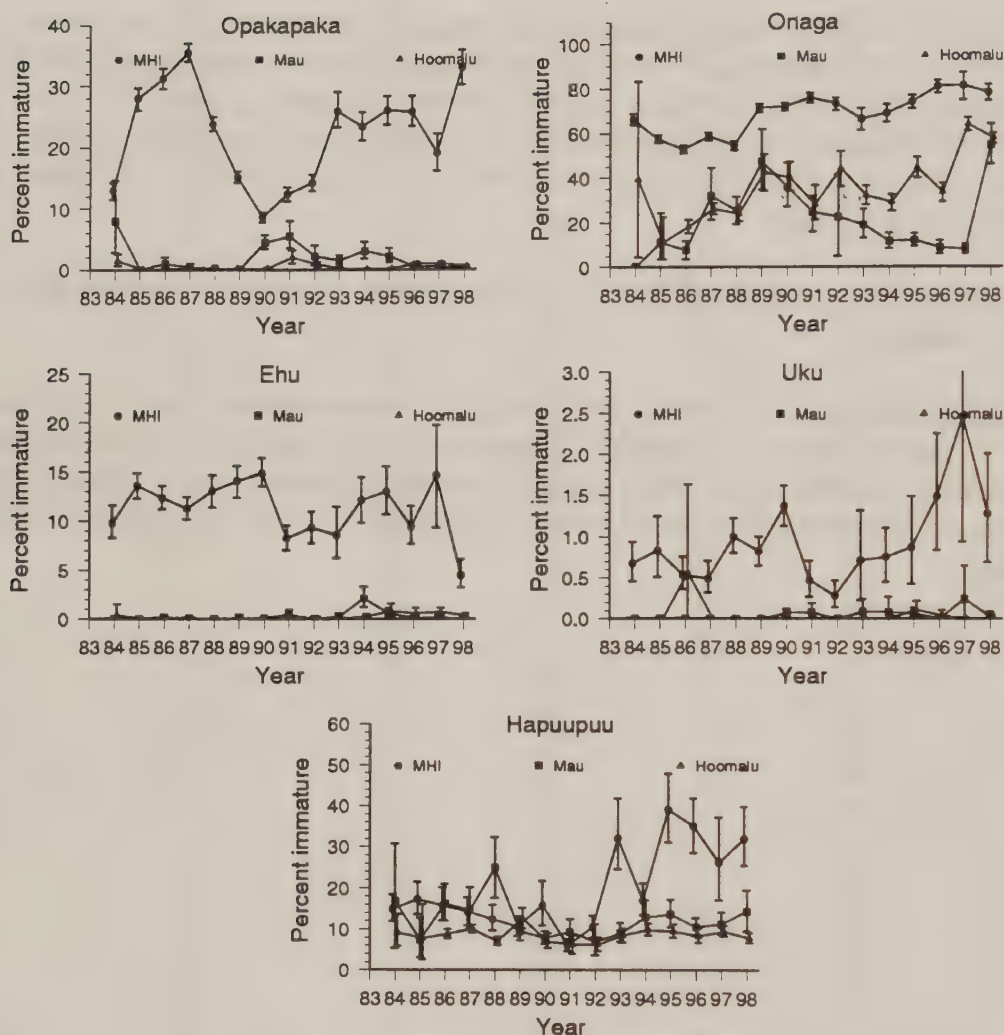
Interpretation: Comparison of CPUE values of the last 10 years (1989-98) with the first 10 years available (1948-57) indicate that all four species for which sufficient data is available have CPUE values less than 50% of original values (and their long-term averages, as well). These values represent a yellow light condition for these four species, with the ehu stocks being the most stressed.

Comments: As in Fig. 15b, there are apparent declines when comparing several recent years with values earlier in the time series. The decline is least apparent in opakapaka and most apparent for ehu. The level of screening done here severely reduces the size of the sample, and this may contribute to some of the observed variability, particularly for ehu where there are fewer targeted trips. Values for hapuupuu are graphed but not put in the table due to the small numbers of targeted trips in most years.

Source: The partial targeted MHI CPUE is based on HDAR C-3 catch report data from commercial fishermen.

Calculation & Adjustment: The data used in Fig. 15a were further screened to only include trips where at least 50% of the total catch by weight is the target species. This can only be done for species that are targeted successfully; incidental catch species will not contribute significantly enough to the overall catch. 95% non-parametric confidence intervals were calculated by bootstrapping.

Figure 16. Percent immature in Hawaiian bottomfish catch



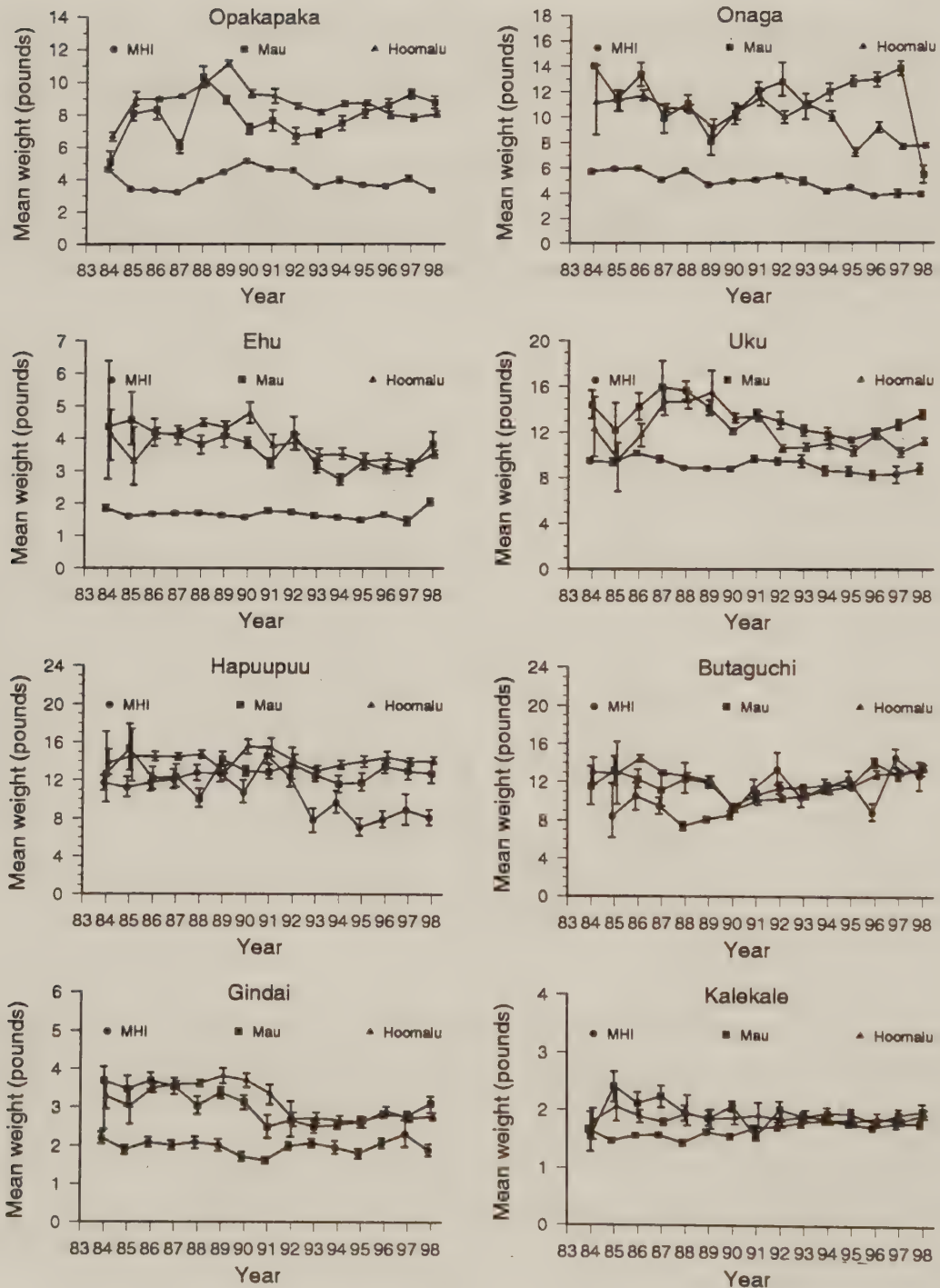
Interpretation: MHI onaga catch has the highest percentage of immature fish, and is the only one consistently over 50%. In 1998 all zones showed onaga landings with over 50% immature fish, signifying a yellow light condition for each zone. This is first year for this yellow light condition in the Mau zone and the second for the Hoomalu zone. This will become a major concern for the NWHI if this greater percentage of immature fish in the catch is sustained over a longer period of time. All other MHI and NWHI stocks are in the healthy range for percentage of immature fish in the catch.

Comments: MHI catch is comprised of more immature fish than NWHI catch. In all areas onaga values are the highest. Percent immature for uku are the lowest (i.e. healthiest) values in all zones. Among the other species, MHI opakapaka experienced periods of relatively high values (peaking in the years 1985-87) and a sharp rise in 1998. MHI hapuupuu percent immature declined from a peak in 1995 to moderate levels in 1997 and 1998.

Source: Fish size data is derived from auction lot statistics obtained at the Honolulu UFA auction by HDAR, NMFS and WPRFMC personnel. Size at maturity from Everson (1984), Everson (1990 unpub. rep.), Everson et al. (1989), Kikkawa (1984), Sudekum et al. (1991).

Calculation & Adjustment: The percent immature is calculated in terms of weight. The size distribution of sold fish is assumed to be representative of all fish caught. Maturity was assumed to be "knife-edge", and all fish in the same sales lot were assumed to be of equal size. 95% non-parametric confidence intervals were calculated by bootstrapping.

Figure 17. Mean weight of Hawaiian bottomfish



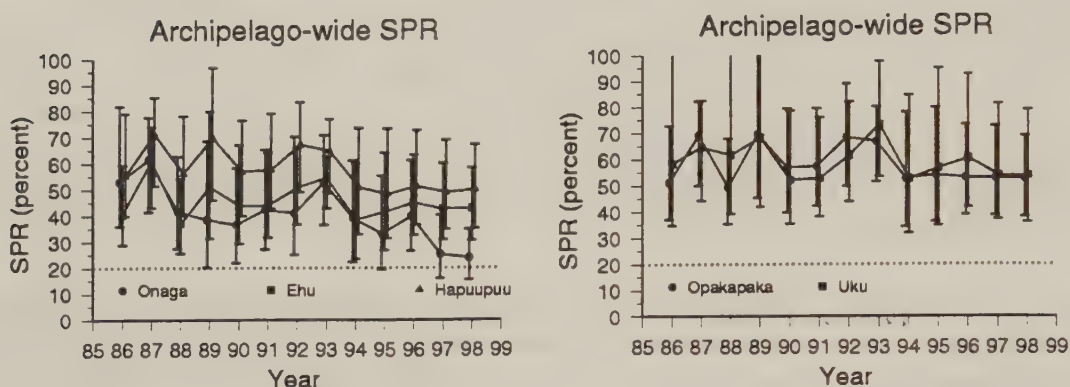
Interpretation: MHI mean weights are considerable lower than NWHI weights indicating considerable stress on these resources. No noticable trends can be seen in NWHI mean weights, indicating relative health in these zones. Low mean weights were first recorded for MHI hapuupuu in 1993 and have remained low through the present. The small number of fish upon which the annual estimates are based may bias the result. However, with so many years in a row recording low mean weights, it is likely that marketed fish size has actually declined for MHI hapuupuu. Such a decline in mean size indicates increased stress on the MHI hapuupuu resource. These values do not exhibit a continuing decline, in fact, the 1997 and 1998 values are slightly greater than the 1995 lowest value.

Comments: Mean weights of fish in the NWHI catch appear generally stable over time, with the notable exception of the onaga mean weight, where recent declines can be seen for both the Mau and the Hoomalu zone. The 1998 Mau onaga value is the lowest on record showing a sharp decline from earlier values. MHI values have been remarkably stable for most species over the time series available, with continuously decreasing sizes found only in the MHI onaga and this decline is very gradual. MHI hapuupuu mean weight has relatively stable after a drop in mean size starting in 1993. The two most important changes in 1998 are the drastic drop in mean size of the Mau zone onaga and the increase in size of the MHI ehu.

Source: Fish size data is derived from auction lot statistics obtained at the Honolulu UFA auction by HDAR, NMFS, and WPRFMC personnel.

Calculation & Adjustment: The size distribution of sold fish is assumed to be representative of all fish caught. All fish in the same sales lot were assumed to be of equal size.

Figure 18. Archipelago-wide Spawning potential ratio (SPR)



Archipelago-wide SPR:

Year	SPR (%)				
	Ehu	Hapuupuu	Onaga	Opakapaka	Uku
1986	41	55	53	51	58
1987	61	71	61	69	65
1988	37	56	42	49	62
1989	51	70	38	69	68
1990	44	57	36	57	52
1991	44	58	42	57	53
1992	51	67	41	68	61
1993	54	65	53	67	73
1994	38	51	39	53	52
1995	41	48	33	54	56
1996	45	51	40	53	60
1997	42	49	25	53	54
1998	43	50	24	52	53
Average	45.67	58.08	41.92	58.08	59.42
Std. Dev.	7.18	8.28	9.72	7.89	6.78

Interpretation: SPR values for the five major BMUS species are all above the 20% critical threshold level when viewed on an archipelago-wide basis. Of these species, onaga usually has the lowest value with the 1998 value at 24%. This low value for onaga is due to the continually worsening condition of the resources in the MHI and the greater than normal percentage of immature fish in the landings from the Mau and Hoomalu zones. Now that the state management plan for the MHI bottomfish has been implemented, it is likely that the condition of onaga resources in this area will improve and the archipelago-wide SPR value will increase over time.

The archipelago-wide SPR estimates are the best method available to assess the Hawaii bottomfish resources and should be the only values used to evaluate overfishing. SPR values are also presented in this document on a management zone basis for the purpose of determining locally depleted resources. It is the best policy to have all zones in a healthy condition and actions should continue to be implemented to assure the achievement of this goal. For the purpose of determining an overfished resource, however, the archipelago-wide condition is what

should be measured. Evidence from larval drift simulation and preliminary genetic work point to as single archipelago-wide stock with substantial larval transfer between zones (generally from the more healthy northwestern zones toward the more depleted MHI zone).

Comments: SPR values for all species fluctuate annually and have wide error bars. There are no particularly obvious trends in SPR values over the 12 year period of data. The only species showing current signs of concern is the onaga for which the lower bound is below the 20% critical threshold value. The management measures implemented by the state for the MHI should bring improvement of the MHI onaga resource over a period of a few years. Any improvements to the MHI resources will contribute to improvement of the archipelago-wide condition as well.

Source: Data used in calculating archipelago-wide SPR is derived largely from HDAR C3 commercial catch records integrated with NMFS interview data. Also important is the size frequency data obtained from market sampling by HDAR and NMFS. The final component is the weighting factor for each management zone, which is based on the percentage of total 100 fathom contour contained in each zone.

Calculation & Adjustment: Calculations use similar methodology as presented in Somerton and Kobayashi (1990) for dynamic SPR. Preweighted SPR values (point estimates and upper and lower bounds) are from the area specific estimates found in the following section (Figure 19, 19a, b, and c). NWHI estimates are calculated using area specific maturity estimates and partial CPUE values (where area specific landings of each species are divided by the total effort expended in the management zone). For the MHI, hapuupuu SPR estimates are calculated similarly to those for NWHI fish. For the remaining MHI species, however, targeted trips are identified and the landings and effort for these targeted trips only are used to calculate CPUE for these species. Weighting factors are applied to point estimate and upper and lower bounds for each species and management zone. Archipelago-wide values are derived by adding the zone specific components. The weighting factors are: MHI = 0.447, Mau zone = 0.124, Hoomalu zone = 0.429.

Figure 19. Spawning potential ratio (SPR) for MHI bottomfish

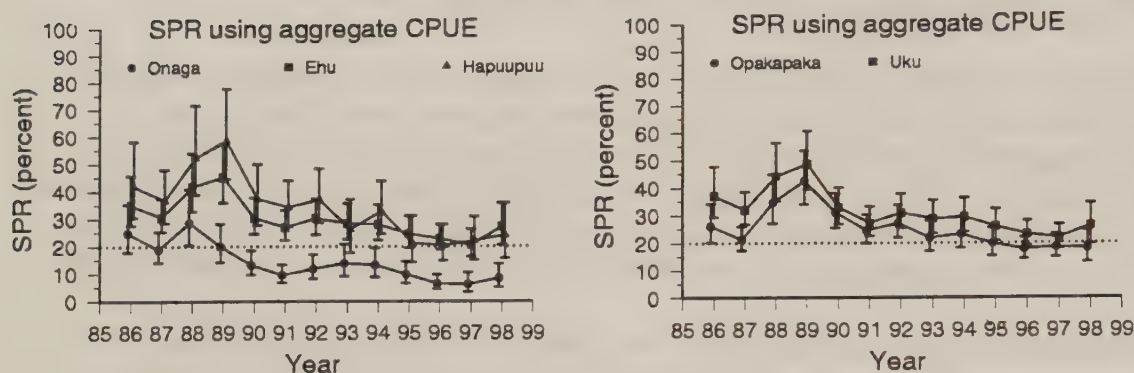


Figure 19 data summary:

Year	SPR (%)				
	Ehu	Hapuupuu	Onaga	Opakapaka	Uku
1986	35	42	25	26	37
1987	31	37	19	21	32
1988	42	52	29	35	44
1989	45	58	20	42	48
1990	30	37	13	31	33
1991	27	34	9	24	27
1992	30	37	12	27	31
1993	28	26	14	22	29
1994	28	33	13	23	29
1995	24	21	10	20	26
1996	23	20	6	18	23
1997	20	22	6	18	22
1998	27	24	8	18	26
Average	30.00	34.08	14.15	25.00	31.31
Std. Dev	7.11	11.78	7.17	7.26	7.73

Interpretation: The peak SPR values observed in 1988-1989 for all species were largely a response to increases in aggregate CPUE due to increased uku landings. 1998 SPR values show improvements over critically low values for all five major BMUS species in 1997. The improvement is largely due to an increase in aggregate CPUE over the low 1997 value. The 1998 value presented here for MHI hapuupuu is the best estimate of MHI SPR available, because we cannot calculate an SPR for this species using targeted CPUE. For the remaining species, the next section (Figure 19a) gives the best estimation of 1998 MHI SPR.

Comments: Current SPR estimates for onaga and opakapaka in the MHI are below the twenty percent critical threshold level indicating localized resource depletion. Onaga remains below 20% for the ninth year in a row. The 1998 SPR value for MHI ehu rose sharply due to an increase in aggregate CPUE and mean fish size. The MHI hapuupuu SPR rose to 26% in 1998.

Source: SPR estimated from the Honolulu UFA auction size frequency data collected by HDAR, NMFS, and WPRFMC personnel; CPUE estimates from C-3 form data reported to HDAR by commercial fishermen. Additional information for opakapaka obtained from size frequency data of fish caught from the R/V Townsend Cromwell.

Calculation & Adjustment: Calculations use similar methodology as presented in Somerton and Kobayashi (1990) for dynamic SPR. Virgin CPUE estimate is 1948-1952 mean; current CPUE estimate is a single year estimate. CPUE is of aggregate bottomfish from the areas of Maui, Lanai, Molokai, and Penguin Banks (see Fig. 15a for more details). Virgin catch size composition is estimated from the 1986-1988 NWHI catch data, and current catch size composition is estimated from single year MHI catch data. All SPR values may have changed slightly from previous year's reports due to more complete reporting and improvements in the calculations. The 90.25% non-parametric confidence intervals were constructed based on "best" and "worst" case bounds of SPR components (CPUE and percent immature).

Figure 19a. Spawning potential ratio (SPR) for MHI bottomfish using targeted CPUE

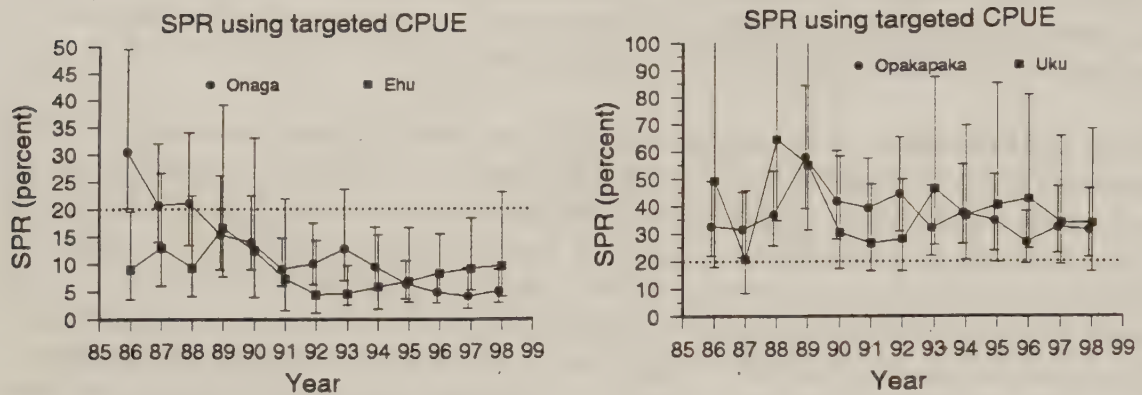


Figure 19a data summary:

Year	SPR (%)			
	Opakapaka	Onaga	Ehu	Uku
1986	32.71	30.37	8.99	49.11
1987	31.43	20.60	12.91	20.57
1988	36.88	21.03	9.30	64.24
1989	57.60	15.31	16.54	54.86
1990	41.73	13.86	12.32	30.29
1991	39.18	8.99	7.23	26.37
1992	44.41	9.95	4.37	28.01
1993	31.93	12.65	4.56	46.13
1994	37.48	9.49	5.76	36.51
1995	34.59	6.34	6.85	40.17
1996	26.96	4.81	8.16	41.15
1997	32.00	4.11	9.16	33.69
1998	31.13	5.01	9.55	33.42
Average	36.77	12.50	8.90	38.81
Std. Dev.	7.89	7.74	3.46	12.28

Interpretation: We feel that SPR values obtained here may better represent the condition of the MHI resources in regards to localized depletion than those found in the previous section. Ehu and onaga stocks are clearly stressed and well below the 20% SPR threshold, with ehu below the 20% level for the duration of our data and onaga on a continuing downward trend with values below 20% for the last 10 years. Of particular concern is the continued decline in onaga SPR

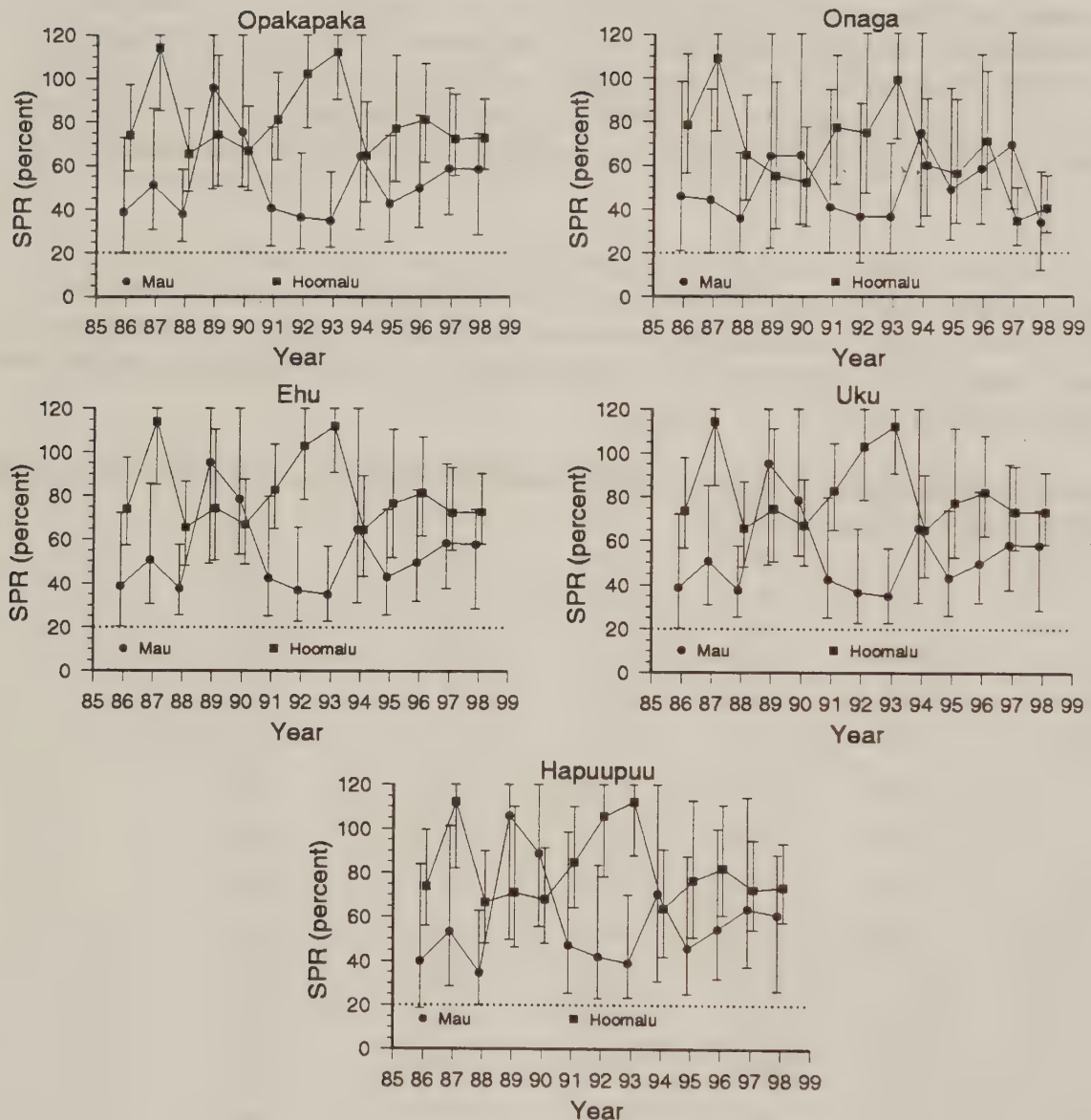
values; ehu values, though low, have not changed much over the years. Contrary to the results obtained in the previous section, opakapaka and uku SPR levels have remained above the 20% mark for all years sampled and do not indicate critical locally depleted conditions.

Comments: This is the fourth year that SPR values have been calculated using targeted CPUE values. These values are available for only four of the BMUS species present in the MHI. As expected onaga and ehu values are below the 0.20 critical level and have been for many years. SPR values for each of these two species are lower using targeted CPUE than they are using aggregate CPUE. Opakapaka SPR values are higher using targeted CPUE compared to using aggregate CPUE. For opakapaka the 1998 SPR value obtained using aggregate CPUE indicates a critical situation (at $SPR = 0.18$) whereas that using targeted CPUE indicates a non-critical level (at $SPR = 0.31$).

Source: SPR values are estimated using the Honolulu UFA auction size frequency data collected by HDAR, NMFS, and WPRFMC personnel; CPUE estimates from C-3 form data reported to HDAR by commercial fishermen and screened for trips targeting particular species. Additional information for opakapaka was obtained from size frequency data of fish caught from the R/V Townsend Cromwell.

Calculation & Adjustment: Calculations are conducted as in the previous section with targeted CPUE substituting for aggregate CPUE.

Figure 19b. Spawning potential ratio (SPR) for NWHI bottomfish



Interpretation: The correlation of SPR values among species is due the high dependence of SPR on the CPUE component, given that the maturity component is nearly negligible. All species utilize the same aggregate bottomfish CPUE component. The maturity component is small relative to MHI SPR calculations because 1) the NWHI catch is primarily mature fish, and 2) the current catch size composition is relatively unchanged from the best estimate of the virgin catch size composition.

Figure 19b data summary:

SPR (%)					
Mau Zone					
Year	Ehu	Hapuupuu	Onaga	Opakapaka	Uku
1986	39	40	46	39	39
1987	51	53	44	51	51
1988	38	35	36	38	38
1989	95	106	64	96	95
1990	78	89	64	75	78
1991	42	47	41	40	42
1992	37	42	36	36	37
1993	35	39	36	35	35
1994	65	71	75	64	66
1995	43	46	49	43	43
1996	50	55	58	50	50
1997	59	59	69	59	65
1998	58	58	74	58	65
Average	52.58	57.25	53.23	52.17	52.67
Std. Dev.	18.56	20.79	14.73	18.58	18.63
Hoomalu Zone					
1986	74	74	78	74	74
1987	114	112	109	114	114
1988	66	67	65	66	66
1989	74	71	55	74	74
1990	67	68	52	67	67
1991	83	85	77	81	83
1992	103	106	75	102	103
1993	112	112	99	112	112
1994	65	64	60	65	65
1995	77	77	56	77	77
1996	81	82	67	81	81
1997	73	73	35	72	78
1998	73	73	94	73	78
Average	82.33	82.50	69.00	82.08	82.42
Std. Dev.	17.55	17.68	20.43	17.45	17.50

Comments: Current SPR estimates for all five species in both zones are above the 20% critical threshold level indicating healthy resources on a local scale, though lower confidence limits often are near or slightly below this level. Mau Zone SPR estimates tend to be lower than Hoomalu Zone SPR estimates for most species, and onaga SPR estimates tend to be slightly lower than those for most other species in most years, though higher in 1998.

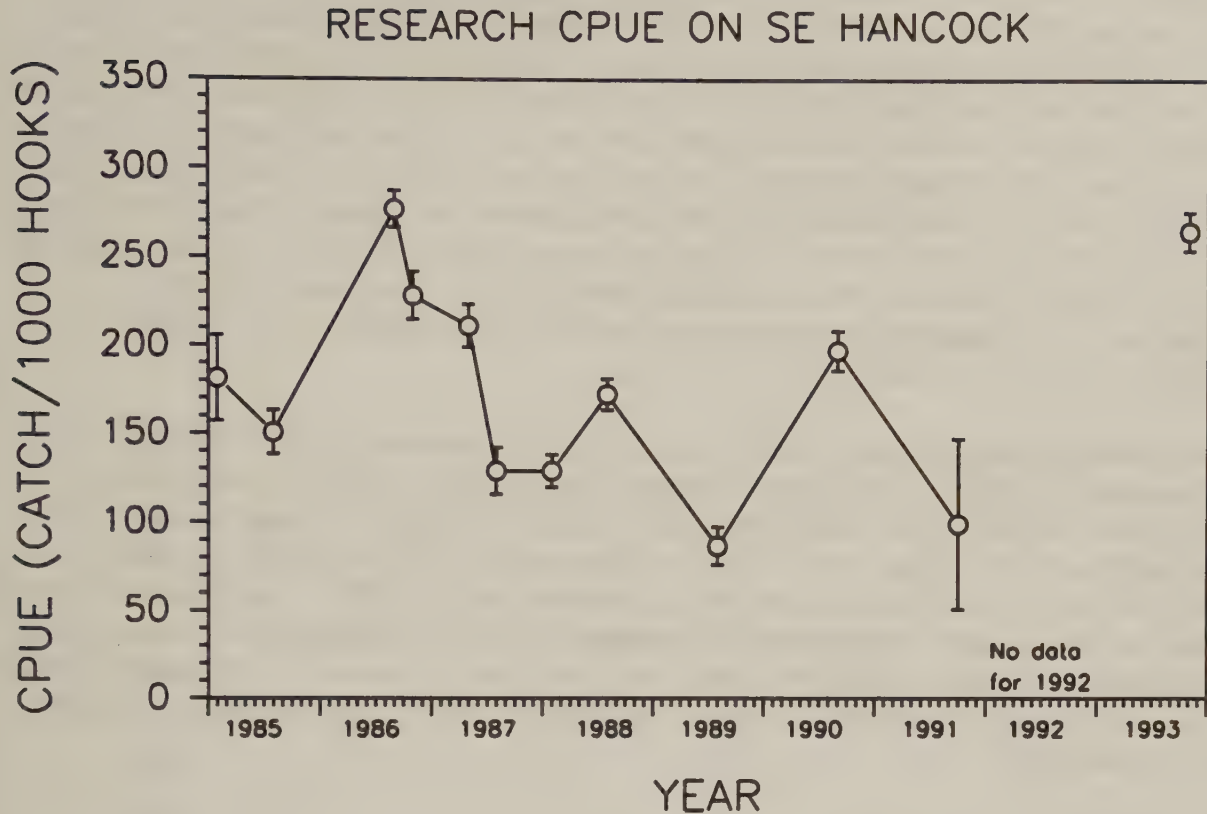
Source: SPR estimated from Honolulu auction size frequency data collected by NMFS personnel, and CPUE estimates from C-3 form data reported to HDAR by commercial fishermen.

Calculation & Adjustment: Calculations use same methodology as presented in Somerton and Kobayashi (1990) for dynamic SPR. Virgin CPUE estimate is 1948-52 mean; current CPUE estimate is a single year estimate. CPUE is of aggregate bottomfish calculated separately for

Mau and Hoomalu Zones. Virgin catch size composition is estimated from the 1986-88 NWHI catch data, and current catch size composition is estimated from single year catch data. All SPR values changed slightly from previous year's reports due to improvements in the calculations. 90.25% non-parametric confidence intervals were constructed based on "best" and "worst" case bounds of SPR components (CPUE and percent immature).

ARMORHEAD STOCK ASSESSMENT

Figure 20



Interpretation: The fluctuations in CPUE shown in Figure 20 are apparently the result of episodic recruitment followed by high natural mortality. These peaks in CPUE correspond to years (1986 and 1990) where an appreciable proportion (at least one-third) of the armorhead population consisted of fat individuals (fatness index ≥ 0.26) considered new recruits to the seamount population. Fatness index is defined as body depth divided by fork length. Subsequent to recruitment individuals cease somatic growth and over the course of 3-4 years, survivors decline in fatness index and weight. Without subsequent recruitment to the population in succeeding years, the armorhead population as a whole would decline both in numbers (natural mortality) and in biomass (natural mortality and declining fatness index of survivors). The high 1993 CPUE is unusual, however, since fat individuals (new recruits) account for $<15\%$ of the 1993 population while leaner individuals (<0.23 in fatness index) form the bulk of the population. These results apparently indicate that the 1993 population is primarily derived from recruitment which occurred either in late 1991 or during 1992. Previous work indicates that little if any annual recruitment to SE Hancock Seamount occurs after the summer months (Humphreys et al. 1993; Fishery Bulletin, U.S. 91:455-463). Since the 1991 stock assessment survey coincided with the end of the summer season, the increase in CPUE at SE Hancock for 1993 is most likely due to good recruitment during 1992. The sharp increase in the 1992 CPUE among

seamounts outside the U.S. EEZ implies that a high recruitment occurred (across all seamounts) in 1992.

Data Source: Figure 20 presents CPUE based on research longline catches at Southeast (SE) Hancock Seamount by NMFS, Honolulu personnel aboard NOAA ship R/V *Townsend Cromwell*. Vertical bars represent the 95% confidence intervals about the mean CPUE. The CPUE derived from the September 1991 stock assessment survey was computed using data from only the first 5 bottom longline sets as opposed to the standard 40 sets used on all other research surveys. The armorhead population at SE Hancock Seamount was not assessed in 1992 and post-1993 and therefore no current CPUE estimates are available. The last stock assessment survey for armorhead at SE Hancock Seamount was conducted in October 1993. Future NMFS armorhead stock assessment cruises to SE Hancock Seamount are unlikely. Henceforth, annual armorhead SPR values for Colahan Seamount (located outside the U.S. EEZ) will be provided to serve as a relative indicator of armorhead stock levels at the Hancock Seamounts (see explanation in Calculations & Adjustments subsection of ARMORHEAD SPAWNING POTENTIAL RATIO section).

Calculations and adjustments: Fishing gear and sampling methods utilized during armorhead stock assessment surveys at SE Hancock Seamount are described in Somerton and Kikkawa (1992; Fishery Bulletin, U.S. 90:756-769). The seamount is divided into quadrants and effort is portioned equally among quadrants. Within each quadrant, effort is conducted over four depth strata (<265 meters (m), 265-300 m, 301-400 m, and 401-500 m). CPUE is calculated as a depth stratified average. Based on gear comparison studies of fishing droppers with and without hook timers conducted on the August 1990 survey, new coefficients accounting for the negative effects of hook timers were computed and applied to the catches obtained on all SE Hancock research surveys since 1985.

Tabulated values:

MONTH/YEAR	ARMORHEAD CPUE
Jan 1985	181.28
Jun 1985	150.51
Aug 1986	276.80
Oct 1986	228.03
Apr 1987	210.98
Aug 1987	128.73
Jan 1988	128.77
Jul 1988	172.14
Jul 1989	86.69
Aug 1990	197.08
Sep 1991	98.97
1992	(unknown)
Oct 1993	264.85
1994-1998	(unknown)

Figure 21. Armorhead Spawning Potential Ratio

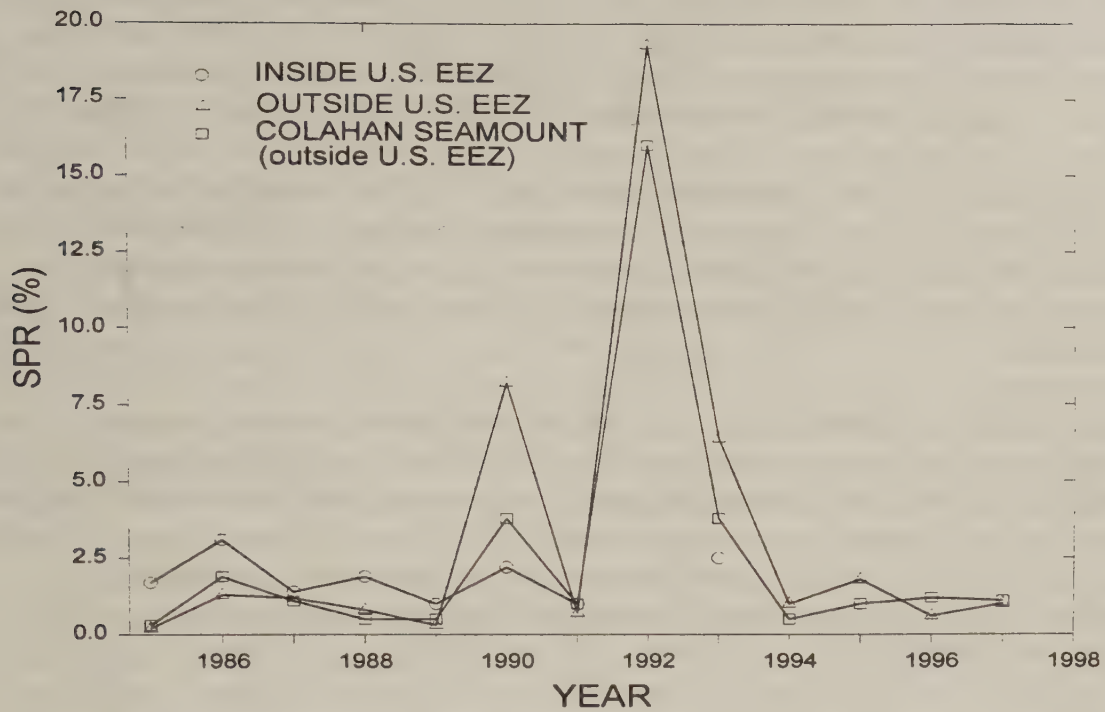
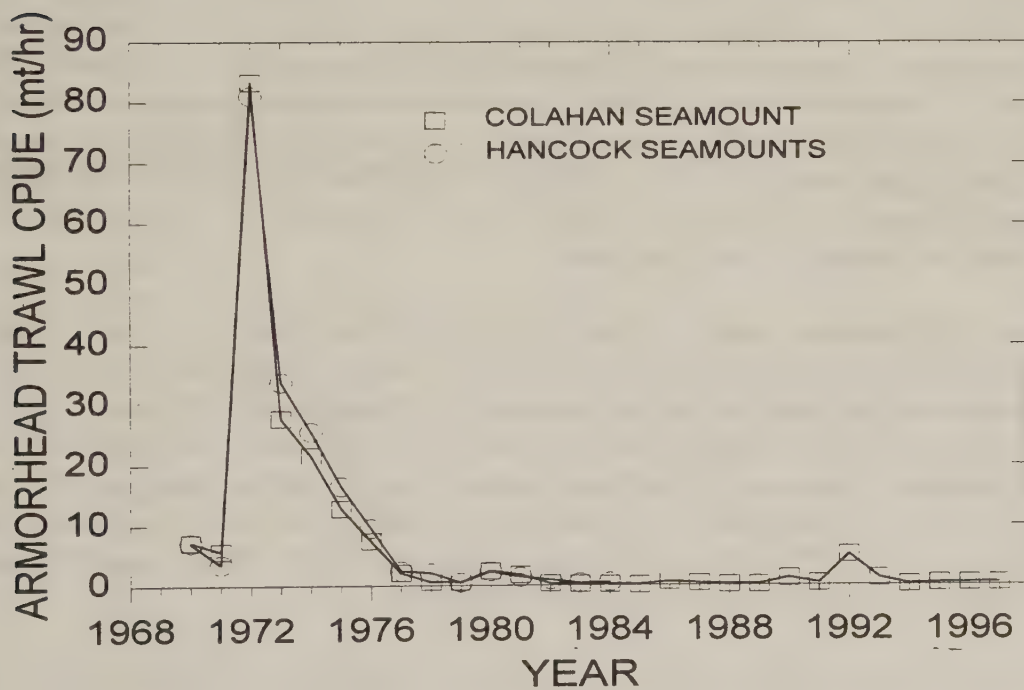


Figure 21. CPUE for Hancock and Colahan Seamounts



Interpretation: SPR within the region outside of the U.S. EEZ, which historically (Japan trawl fleet during the 1969-1981 period) contributed 91% of the total catch of armorhead, is 1.0%; based on the most current (1997) available catch and effort statistics from the Japan North Pacific trawl fishery. The 1996 SPR of 0.4% in last year's report was incorrect; the correct value (0.6%) however was only slightly higher. These low SPR values for the last two years of data indicate a continued depression in stock levels since the dramatic increase of SPR levels outside the U.S. EEZ in 1992 and the equally dramatic decline and continued low levels since then. This continuation of low stock levels outside the U.S. EEZ is interpreted to be a result of the intensive fishing effort on the high 1992 recruitment pulse coupled with little subsequent recruitment during 1993-1997 to compensate for losses due to fishing and natural mortality. Based on previous trends, catch levels are expected to remain low in 1998 unless offset by a large recruitment event.

Based on current estimates of a 2-2.5 year pelagic phase prior to seamount recruitment, the 1992 recruitment would have originated from the 1989-1990 winter spawning season. If this is correct, then the large 1992 recruitment originated from a parental stock which in 1989 had one of the lowest SPR values both inside and outside the U.S. EEZ (see table next page). This would appear to support the notion that dramatic increases in armorhead abundance across the seamounts are episodic and the product of environmental factors rather than simply a stock-recruitment relationship.

During February-March 1997, an oceanographic and larval armorhead survey over the seamounts outside the U.S. EEZ was conducted onboard the R/V *Kaiyo Maru* by the National Research Institute of Far Seas Fisheries Laboratory in Shimizu, Japan. Initial plans were to include research trawl hauls over Colahan Seamount, however, the ship was no longer equipped to conduct bottom trawl operations. Armorhead larvae were collected from surface waters around the Milwaukee Seamounts group, Colahan and C-H Seamount, but were absent from Koko Seamount. This same vessel conducted a research survey of pelagic stage armorhead in open ocean waters of the North Pacific during November 1998. The major objective was to tag-and-release pelagic specimens from various locations distant from the seamounts in hopes of later obtaining seamount re-captures and movement data. Unfortunately, no pelagic stages of armorhead were encountered during this cruise.

Data source: SPR values for seamounts outside the U.S. EEZ are based on reported catch and effort data from the Japanese trawler fleet and values for seamounts within the U.S. EEZ (Hancock Seamounts) are based on research longline CPUE in addition to the trawl CPUE. However, with the cessation of research longline cruises to the Hancock Seamounts, SPR values for Colahan Seamount (comparable in size and located closest to the Hancocks among seamounts outside the U.S. EEZ) are being provided now and in the future as an indicator of stock levels at the Hancock Seamounts. SPR values for Colahan Seamount are also based on reported catch and effort data at that seamount by the Japanese trawler fleet.

Calculations and Adjustments: SPR values outside the U.S. EEZ are computed as the current year CPUE divided by the average CPUE during the first three years of the fishery (1970-1972). SPR values inside the U.S. EEZ are computed as the estimated biomass on SE Hancock

Seamount divided by the 1970-1972 average biomass. Biomasses are estimated using procedures described in Somerton and Kikkawa (1992). The SPR values for Colahan Seamount are computed as the current year CPUE divided by the average CPUE during the first three years of the fishery (1970-1972) at Colahan Seamount (Figure H-19). Fishery catch and effort data by seamount by month for seamounts outside the the U.S. EEZ have been provided annually since 1980 by colleagues at the National Research Institute for Far Seas Fisheries in Shimizu, Japan.

The decision to use SPR values for Colahan Seamount (instead of the overall outside U.S. EEZ values) as an indicator of armorhead stock conditions inside the U.S. EEZ (i.e., Hancock Seamounts) is based on the greater similarities between these seamounts. Aside from Colahan Seamount, the seamounts fished for armorhead outside the U.S. EEZ are Milwaukee Seamounts and Koko Seamount. These latter seamounts have summit areas of 67 and 564 nm² and average summit depths of 190 and 170 fm, respectively, while Colahan and the Hancock Seamounts have much smaller summit areas (about 1.4 nm²) and shallower summit depths (141-150 fm). Fishing effort by the Japan trawl fleet has historically been different at these two types of seamounts. Koko and Milwaukee Seamounts have always received the majority (about two-thirds) of the annual total trawling effort and were typically fished intensively over a sustained period of time. However, the fishing effort at Colahan and the Hancock Seamounts was applied in pulses since catch levels could not be sustained for more than several days without a "cooling off" period. These similarities plus the historical close coincidence between Colahan and Hancock Seamounts in temporal profiles of armorhead CPUE from the Japan trawl fleet (Figure H-20) indicate that SPR values for Colahan Seamount should provide the best future indicator of armorhead stock levels at the Hancock Seamounts.

Tabulated Values:

ARMORHEAD SPR (%)			
YEAR	INSIDE US EEZ	COLAHAN	OUTSIDE US EEZ
1985	1.7	0.3	0.2
1986	3.1	1.9	1.3
1987	1.4	1.1	1.2
1988	1.9	0.5	0.8
1989	1.0	0.5	0.3
1990	2.2	3.8	8.2
1991	1.0	1.0	0.7
1992	NA	16.0	19.3
1993	2.5	3.8	6.4
1994	NA	0.5	1.0
1995	NA	1.0	1.8
1996	NA	1.2	0.6
1997	NA	1.1	1.0
1998	NA	NA	NA

Management Issues: Effective September 1, 1998, the fishing moratorium on seamount groundfish at the Hancock Seamounts was extended for a third 6-year period until August 31, 2004. Based on current sustained low SPR values both at Colahan Seamount and at all SE-NHR seamounts outside the U.S. EEZ, it was inferred that the status of the Hancock Seamounts armorhead resource was similarly depressed. The intent of the moratorium is to provide continued long-term protection (which is absent elsewhere within the seamount habitat of the SE-NHR) to enhance the possibility of the armorhead resource to re-build via recruitment.

Appendix 4

Commonwealth of the Northern Mariana Islands

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Summary

Through documentation of increased landings it is apparent that bottom-fishing activity in the NMI has continues to be greater than the decline experienced seven years ago. In 1998, bottomfish landings decreased by 9.8% from 1997, though exceeding the 1995 landings by 60%. Domestic US, joint-venture, and foreign vessels are still inquiring about full-time bottom-fishing throughout much of the NMI. The impact to the commercial market is still unclear despite a fish market assessment study that was conducted in 1994, but only recently completed in late 1996. This study did not correspond with the significant increase in the Northern Islands bottomfish harvest.

The number of large-vessel commercial bottom-fishing ventures active in the Northern Islands decreased from three to one by the end of 1998. It appears as though one company will not attempt to re-enter the fishery. Commercial trips continue to be sampled on a monthly basis.

Revenues and prices will probably continue to increase with renewed fishing interest, larger financial investment, and increased utilization of modern electronics and equipment. Deep-water snappers still command the best prices. Fishermen utilizing larger vessels will have greater access to these deep-water resources, especially in the Northern Islands of the NMI. Subsequently, the market demand should continue to increase as long as the supply of these fish increases with consistent quality. This industry could continue to expand with potential support by a training program in bottom fishing that addresses the following; proper fish handling, use of fathometers, nautical charts, modern electronic equipment such as GPS, fish finders, electric reels, plus anchoring techniques and marketing.

With the potential expansion of biological data collection from the bottom fishery, as well as DFW fishing surveys, an assessment with the aid of the National Marine Fisheries Service, should be completed for the bottomfish stocks surrounding Saipan. After identifying the extent of resource utilization, additional data collecting could be used to help determine comprehensive management strategies. Continued sampling of vessels fishing bottomfish plus actual fishing by DFW in the Northern Islands of the NMI would provide comparable estimates of CPUE.

Historical Annual Statistics					
Years	Total Landings (lb) all Bottomfish	CPUE (Lb/trip)	Inflation adjusted Revenues(\$)	Bottomfish \$/Lb	Number of Boats
1983	22,683	43	75,206	3.32	90
1984	33,924	69	101,489	2.99	102
1985	32,780	116	91,957	2.81	55
1986	23,929	104	73,028	3.05	54
1987	39,772	168	111,395	2.80	42
1988	37,850	179	101,506	2.68	29
1989	19,550	76	57,517	2.94	29
1990	10,903	85	35,010	3.21	29
1991	5,693	46	19,825	3.48	20
1992	8,148	58	23,766	2.92	38
1993	14,769	85	40,668	2.75	20
1994	20,363	74	59,789	2.94	32
1995	28,744	93	99,944	3.48	33
1996	52,967	119	178,474	3.37	70
1997	50,851	136	168,890	3.32	68
1998	45,835	145	156,256	3.41	50
<i>Averages</i>	28,048	100	87,170	3.09	48
<i>St.Deviation</i>	14,813	41	49,249	0.28	24

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Introduction

The Northern Mariana Islands (NMI) bottomfish fishery occurs primarily around the islands and banks from Rota Island to Zealandia Bank north of Sariguan. However, this discussion will be limited to the catches landed on Saipan which is by far the largest market. The fishery will be characterized by data collected through the Commercial Purchase Data Base which indirectly records actual landings by recording all local fish sales to commercial establishments. This data collection system is dependent upon first-level purchasers of local fresh fish to accurately record all fish purchases by species categories on specially designed invoices. Division of Fish and Wildlife (DFW) staff routinely collect and distribute invoice books to 95 participating local fish purchasers; which include practically all fish markets, stores, restaurants, hotels, government agencies and roadside vendors (fish-mobiles). Although this data collection system has been in operation since the mid-1970s, only data collected since 1983 are considered accurate enough to be comparable for most aspects of the fishery.

The NMI's bottom-fishery still consists primarily of small-scale local boats engaged in commercial and subsistence fishing, but in recent years larger vessels (35'-50') have entered the fishery. The bottom-fishery is broken down into two categories; deep (>500 ft) and shallow (100-500ft) water fishing. The deep water fishery is primarily commercial, targeting snappers and groupers. The snappers targeted include the Eteline and *Pristipomoides* complexes, whereas the Eight-banded grouper (*Epinephelus octofasciatus*) is exclusively targeted. The shallow water fishery, which targets the Red-gilled emperor (*Lethrinus rubrioperculatus*), is mostly commercial but also includes subsistence fishermen. Hand lines, home fabricated hand reels and electric reels are the common gear used for small-scale fishing operations, whereas electric reels and hydraulics are the common gear used for the larger operations in this fishery. Historically, some trips have lasted for more than a day, but currently, however, effort is defined and calculated on a daily trip basis. Fishing trips are generally restricted to daylight hours, with all vessels returning before or soon after sunset, unless fishing in the Northern Islands. In terms of participation the bottomfish fleet consists primarily of vessels less than 24 feet in length which are usually limited to a 25-mile radius from Saipan. The larger commercial vessels that are able to fish extended trips and which focus their effort from Esmeralda Bank to Zealandia Bank, have landed the majority of the bottomfish reported through the purchase receipt form. In 1998, one commercial venture fished during the entire year in the Northern Islands of the NMI. This company fished with one boat targeting primarily Onaga (*Etelis coruscans*), the Eight-banded grouper, and the Red-gilled emperor. The company which started toward the end of 1997 fished intermittently in 1998 with little success, finally going out of business in late 1998.

Bottom-fishing requires more technical skill than pelagic trolling, including knowledge of the location of specific bathymetric features. Presently, bottom-fishing can still be described as "hit or miss" for most of the smaller size (14-25 ft.) vessels. Without fathometers and even nautical charts, the majority of fisherman utilizing smaller vessels often rely on land features for guidance to a fishing area. This type of fishing is inefficient and usually results in a lower catch per unit of effort (CPUE) in comparison with pelagic trolling. Larger sized (25 ft. and above) vessels typically utilize Global Positioning System (G.P.S.), fathometers and electric reels, resulting in a far more efficient operation.

Recommendations

1) To request NMFS and the Council to assist DFW in adequately assessing the status of bottomfish stocks in the Southern Islands of the CNMI.

2) Establish baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/Northern Marianas deep-water bottomfish complex (e.g., survey on grouper, snapper) utilizing data collected during Resource Assessment Investigation of the Marianas Archipelago (RAIOMA) cruises (1981-1984), the current fishing in the Northern Islands and sampling aboard DFW research vessel to help calculate SPR, with assistance from NMFS.

3) Establish baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/Northern Marianas shallow-water bottomfish complex (e.g. red-gilled emperor) by sampling program aboard DFW research vessel to help calculate SPR, with assistance from NMFS.

4) With assistance from NMFS/WPacFIN, software should be developed and implemented to separate fishery statistics for the main islands fishery and from the Northern Islands fishery with separate descriptions and statistics reported in the annual report module.

Table 1. NMI 1998 commercial landings of bottomfish species

Species	Landings (lb)	Revenue (\$)	Ave. Price (\$/lb)
Unidentified Bottomfish	5881	16224	2.76
Jacks	1904	6332	3.33
Ehu	158	532	3.38
Gindai	1036	3499	3.38
Grouper	6291	18739	2.98
KaliKali	473	2012	4.26
Onaga	11753	50789	4.32
Opakapaka	2183	7015	3.21
Lehi	4822	19243	3.99
Amberjack	254	841	3.32
Emperor	11082	31027	2.80
Subtotal	45835	156256	3.41

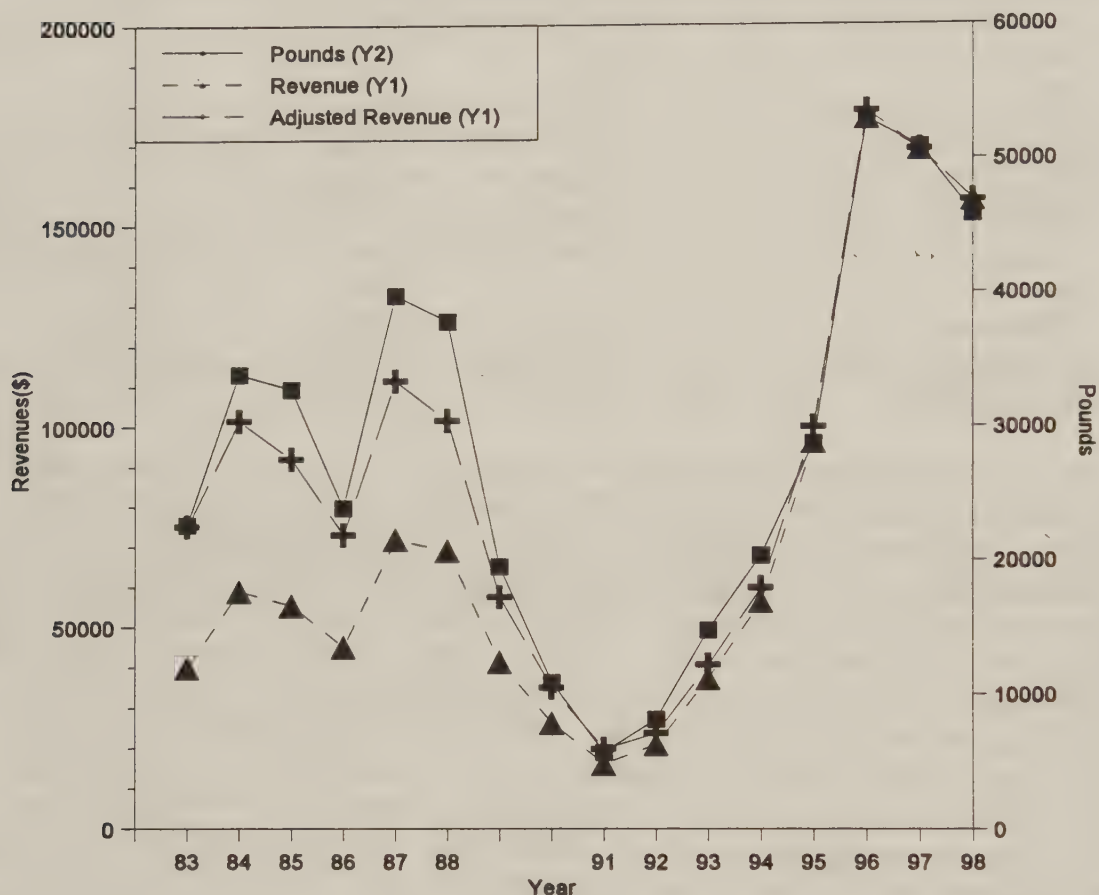
Interpretation: The percentage of bottomfish not identified to purchase receipt classification increased from 6% in 1997 to nearly 13% in 1998. The primary reason for this is unknown. It may have been due to the new company that entered the Northern Islands fishery in late 1997, that had little success and eventually ceased operations by the end of 1998. This company routinely grouped species on the vendor slip. A notable change from 1997 was the 46% decrease in landings of the Red-gilled emperor, from 20,355 to 11,082 pounds. This approached the 1996 value of 9,592 pounds. This was due to the decrease in consistently active vessels fishing the Northern Islands from two in 1997 to one by the end of 1998. This species continued to be a seasonal favorite of smaller (25-30 foot) vessels harvesting around the island of Farallon de Mendinilla. The 'jacks' category also decreased as a result of the decreased landings of the Black Jack (*Caranx lugubris*), taken in the same depth range as the Red-gilled emperor. Both the Eight-banded grouper and the Onaga remained decrease from 1997. Lehi (*Aphareus rutilans*) landings increased 338% to an all-time high 4,822 pounds. It was expressed by fishermen from the major Northern Islands venture that Lehi were being caught instead of Onaga in some locations.

Landings of Gindai increased 58% from 1997. Landings of the Opakapaka group remained stable from 1997.

Onaga continued to command the highest price per pound, followed by the KaliKali. All bottomfish prices increased, except for Unidentified bottomfish, Lehi, Opakapaka, and Mafute. The mean price per pound for bottomfish increased from 3.32 in 1997 to 3.41 in 1998.

Calculation: Annual summaries for each species from invoice data sheets.

Figure 1. 1998 NMI commercial bottomfish landings and revenue.

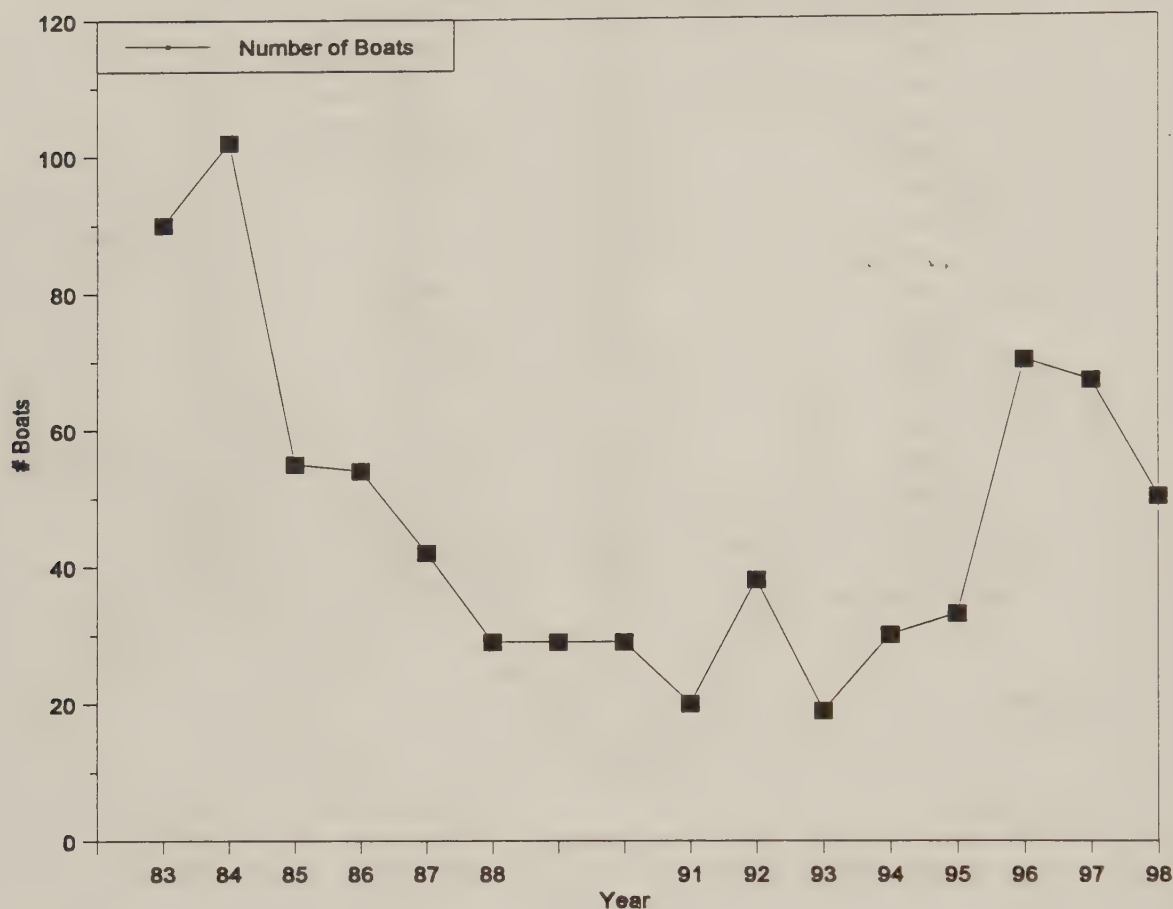


Interpretation: Landings, revenues and adjusted revenues for 1998 have remained relatively constant from 1996, although the average from each category has decreased from 1997. This is attributed to the decrease in bottomfish effort concentrated in the Northern Islands.

Calculation: Landings in pounds are from a simple data base summation of reported purchases of all bottomfish species combined. Revenue in dollars is from the same type of data base summation of the value field. The inflation adjustment is made using the Consumer Price Index (CPI) and establishing the 1998 CPI figure as the basis by which calculations of previous years' prices are made.

Year	Pounds	Unadjusted Revenue	Inflation-Adjusted Revenue
1983	22,683	40,003	75,206
1984	33,924	59,005	101,489
1985	32,780	55,396	91,957
1986	23,929	45,079	73,028
1987	39,772	71,868	111,395
1988	37,850	69,052	101,506
1989	19,550	41,379	57,517
1990	10,903	26,323	35,010
1991	5,693	16,118	19,825
1992	8,148	21,032	23,766
1993	14,769	37,310	40,668
1994	20,363	56,405	59,789
1995	28,744	96,100	99,944
1996	52,967	176,707	178,474
1997	50,851	168,890	168,890
1998	45,835	156,256	156,256
Average	28,048	71,058	87,170
Standard Deviation	14,813	51,904	49,249

Figure 2. Number of Fishermen (boats) making bottomfish landings.



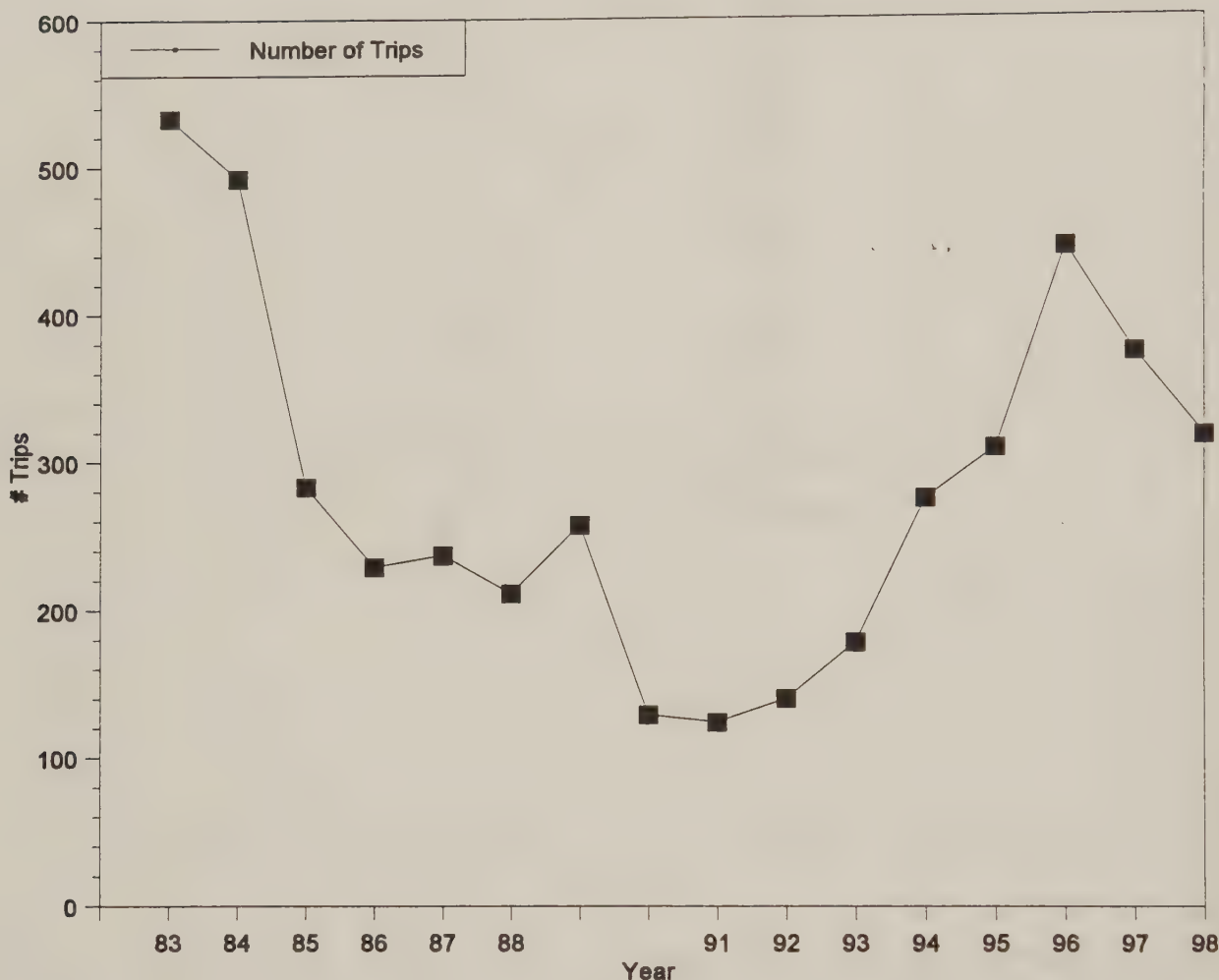
Interpretation: As with the number of trips (Fig. 3), the number of boats or fishermen making commercial landings of any bottomfish species declined from 1984 to 1988, stabilized between 1988-90, slightly increased during 1992, decreased again in 1993, then increased during 1994 and 1995, and increased 100% in 1996. The number of vessels making bottomfish trips decreased slightly from 1996.

More smaller vessels are fishing 'mixed' trips over past years. That is smaller vessels are both trolling and Bottom fishing on a single trip.

Calculation: The fisherman or boats selling the catch is identified on the "trip ticket" invoices used by purchasers. The plot shows the number of unique fishermen making any landings of bottomfish within a given year.

Year	Boats
1983	90
1984	102
1985	55
1986	54
1987	42
1988	29
1989	29
1990	29
1991	20
1992	38
1993	20
1994	32
1995	33
1996	70
1997	68
1998	50
Average	48
Standard Deviation	24

Figure 3. Number of NMI bottomfish trips.

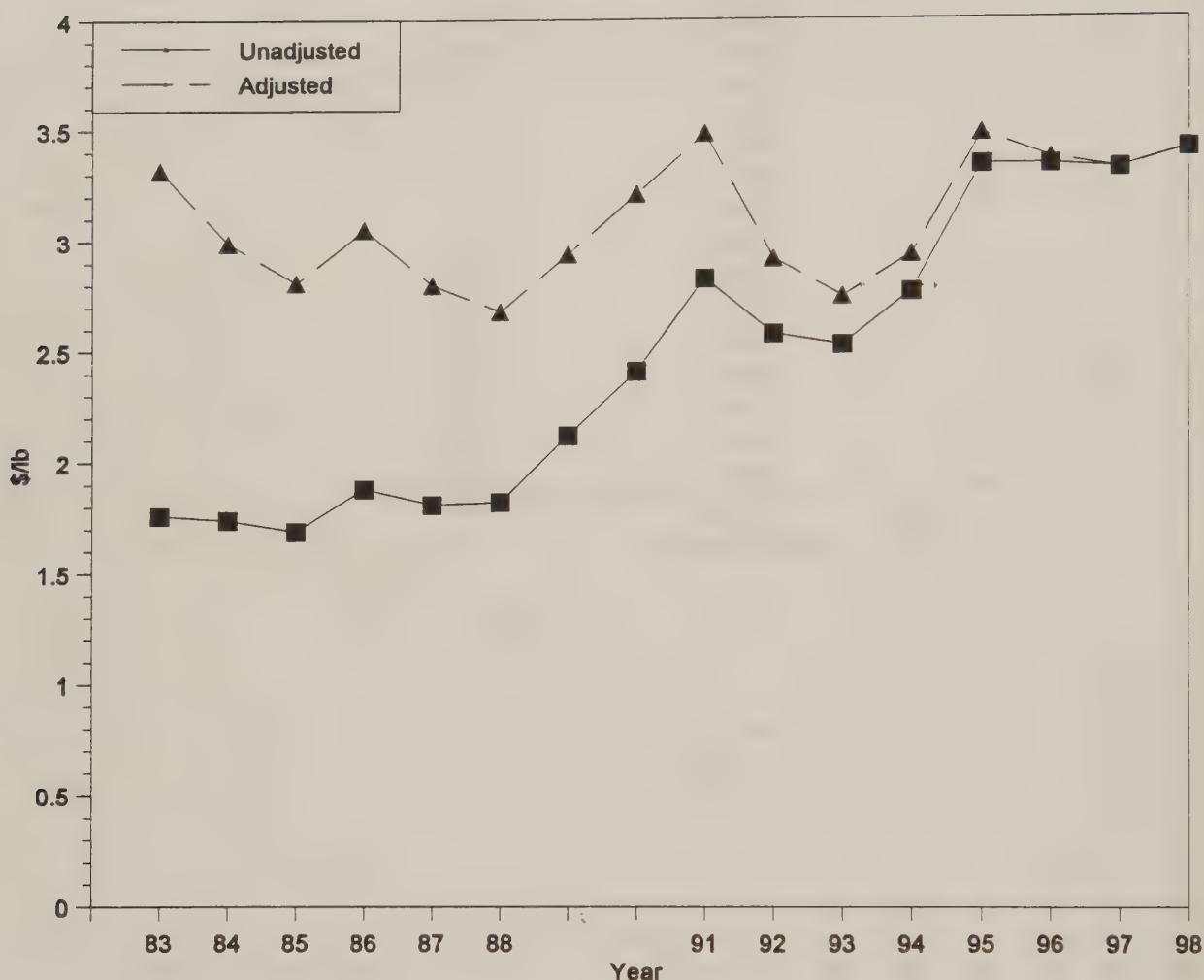


Interpretation: The number of bottomfish trips decreased 15% from 1997. This corresponds with the number of vessels making bottomfish trips, and the decrease in the number of fishing trips by the commercial ventures to the Northern Islands.

Calculation: The number of trips which resulted in landing any bottomfish are tallied by adding each recorded fisherman's trip on a given day. This assumes that each fisherman lands only once in a given day, and that all of the catch is sold on that day. Most trips last a single day, but it is also known that the occurrence of longer fishing trips is increasing.

Year	Trips
1983	533
1984	492
1985	283
1986	229
1987	237
1988	211
1989	257
1990	129
1991	124
1992	140
1993	178
1994	275
1995	309
1996	445
1997	374
1998	317
Average	283
Standard Deviation	125

Figure 4. NMI average price of bottomfish.

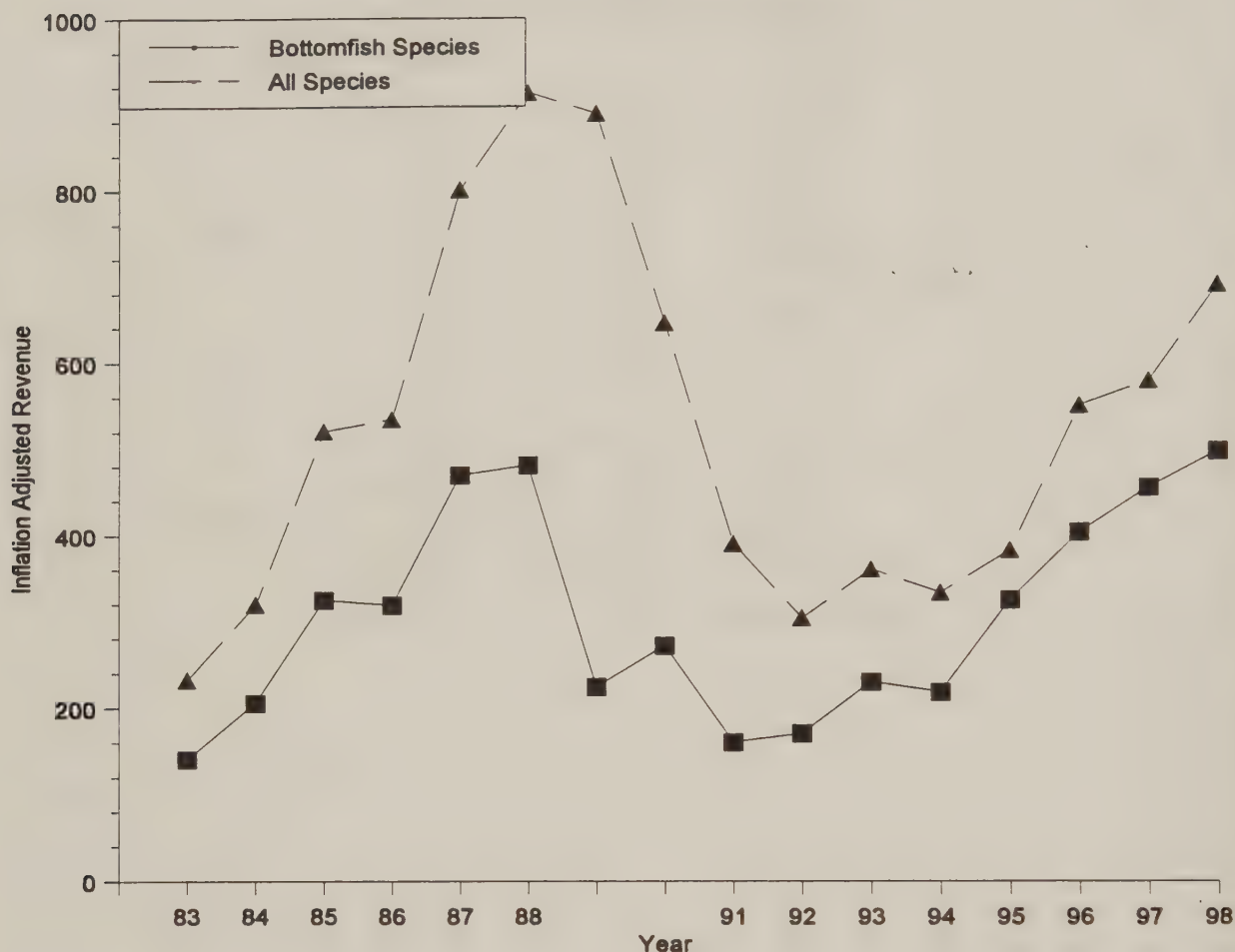


Interpretation: The average price increased steadily from 1988 to 1991, where it reached what was once a record high of \$2.83. In 1995 the price increased to a new record high of \$3.34. This price remained constant through 1997, and increased to a new record high of \$3.41 in 1998. Re-sold catches are not included in this report.

Calculation: The average price of the bottomfish complex is calculated by dividing the total revenue by the total landings. The inflation adjustment is made using the Consumer Price Index (CPI) and establishing the 1998 CPI figure as the basis by which calculations of previous years' prices are made. The CPIs for 1983-87 were not available from the appropriate NMI agency and were, therefore, estimated by using Guam's annual inflation rate to proportionately adjust the 1988 NMI CPI.

Year	Unadjusted \$/lb	Adjusted \$/lb
1983	1.76	3.32
1984	1.74	2.99
1985	1.69	2.81
1986	1.88	3.05
1987	1.81	2.80
1988	1.82	2.68
1989	2.12	2.94
1990	2.41	3.21
1991	2.83	3.48
1992	2.58	2.92
1993	2.53	2.75
1994	2.77	2.94
1995	3.34	3.48
1996	3.34	3.37
1997	3.32	3.32
1998	3.41	3.41
Average	2.46	3.09
Standard deviation	0.65	0.28

Figure 5. NMI average inflation adjusted revenue per trip landing bottomfish

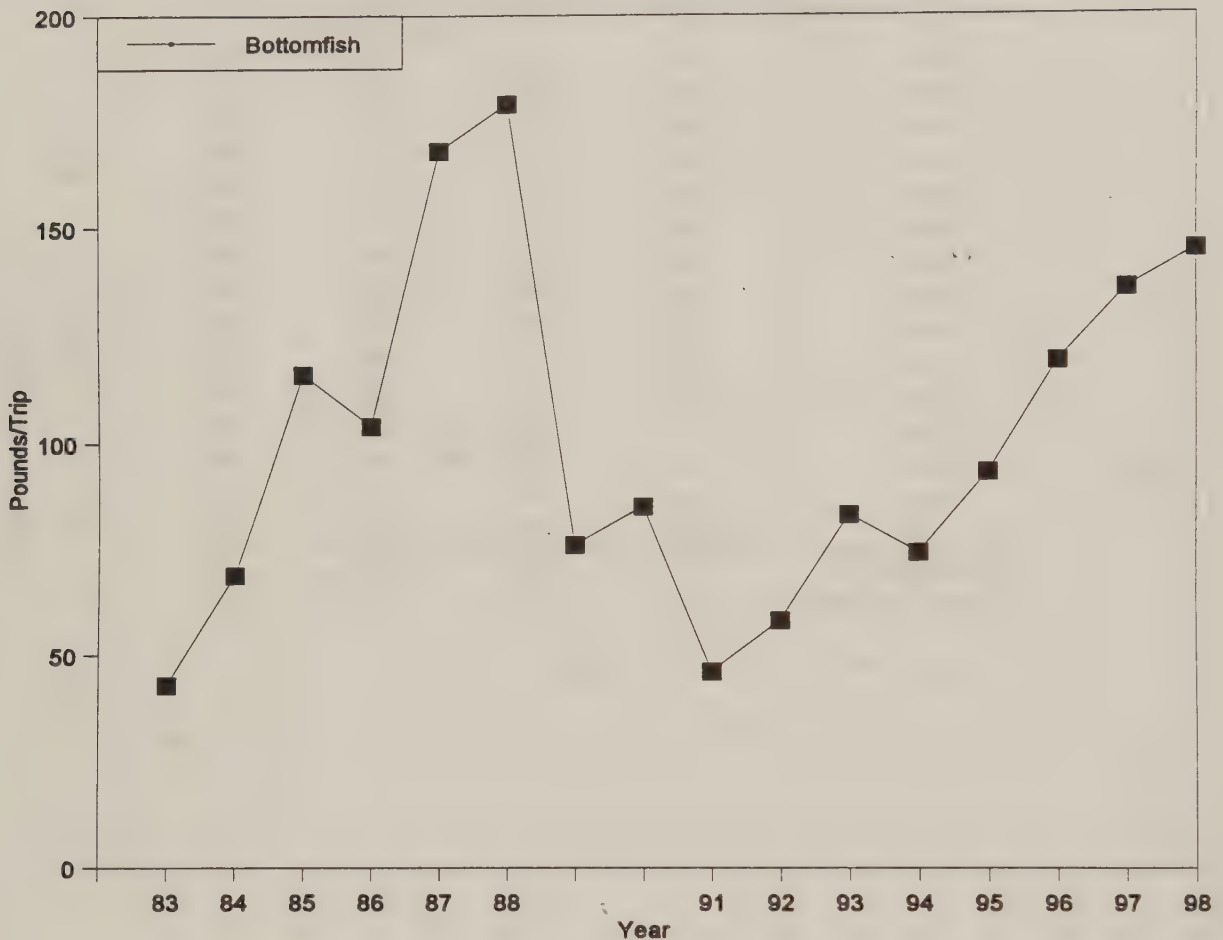


Interpretation: Inflation adjusted bottomfish revenue in 1998 increased over 1997, continuing a trend begun in 1995. The ‘bottomfish species’ inflation adjusted revenue increased 9% from 1997, and the ‘all species’ inflation adjusted revenue increased 19% from 1997. The bottomfish fishery has always been a small proportion of the total fisheries, but it appears that bottomfish are comprising a relatively higher percentage of the trip revenue on trips where bottomfish were caught.

Calculation: Only trips which landed bottomfish are included in these calculations. “Bottomfish \$/Trip” is the total revenue of the bottomfish sold from a trip, and “all Species \$/Trip” is the total trip revenue of all species combined (e.g. any pelagic and reef fish which were sold). The inflation adjustment is made using the Consumer Price Index (CPI) and establishing the 1998 CPI figure as the basis by which calculations of previous years’ prices are made. The CPIs for 1983-87 were not available from the appropriate NMI agency and were, therefore, estimated by using Guam’s annual inflation rate to proportionately adjust the 1988 NMI CPI.

	Bottomfish Species		All Species	
Year	Unadjusted	Adjusted	Unadjusted	Adjusted
1983	75	141	124	233
1984	120	206	186	320
1985	196	325	314	521
1986	197	319	330	535
1987	303	470	517	801
1988	327	481	621	913
1989	161	224	639	888
1990	204	271	485	645
1991	130	160	316	389
1992	150	170	268	303
1993	210	229	329	359
1994	205	217	313	332
1995	311	323	366	381
1996	397	401	542	547
1997	452	452	575	575
1998	493	493	685	685
Average	246	305	413	527
Standard Deviation	122	122	169	213

Figure 6. NMI bottomfish catch in average pounds per trip



Interpretation: The average pounds per trip of bottomfish increased 6.6% over 1997, and 22% over 1996. The substantial increase since the low in 1994 can be primarily attributed to the Northern Islands fishery.

Calculation: The average catch per trip is calculated by dividing the total weight of all bottomfish landings by the number of trips which landed bottomfish, regardless of the amount of bottomfish landed on any given trip. Although the average catch per trip is not a very good measure of CPUE, because it is subject to significant biases (e.g. changes in trip length and relative amounts of Bottom fishing compared to trolling), it is the only measure readily possible from the commercial landings system. It may be possible to improve this measure of CPUE by using only those trips which landed bottomfish exclusively, but that has not yet been accomplished.

Year	Pounds per Trip
1983	43
1984	69
1985	116
1986	104
1987	168
1988	179
1989	76
1990	85
1991	46
1992	58
1993	85
1994	74
1995	93
1996	119
1997	136
1998	145
Average	100
Standard Deviation	41

Appendix 5. NMFS 1998 Administrative Activities

Northwestern Hawaiian Islands (NWHI) Bottomfish Fisheries

During calendar year 1998, The Pacific Islands Area Office (PIAO) in Honolulu, issued a total of 21 permits for the NWHI bottomfish fishery. Seven vessels were registered for the Ho'omalulu Zone (limited access program) fishery; 14 vessels were registered with Mau Zone (open access program) permits. During 1998, there were 10 fewer vessels fishing in the Mau zone from the previous year.

Ho'omalulu Zone (limited access) vessels:

1. Deborah Ann
2. Fortuna
3. KaImi Kai
4. Kealailani
5. Laysan
6. Island Girl (replaced Nesika)
7. Windwalker

Mau Zone (open access) vessels:

1. Aikane 49
2. Amber Rose
3. Boomerang
4. Dasher II
5. Honua-Oe
6. Imua
7. Iwalani
8. Jamie Elizabeth
9. Kai Pali
10. Leo Marie
11. Na Alii Kai II
12. Ruthles
13. Shanatu
14. Wahine Kapaloa I

Appendix 6. USCG and NMFS 1998 Enforcement Activities

The following report is a combined effort of the U.S. Coast Guard 14th District and the NMFS Southwest Region Office of Enforcement. The report covers the period 1 January 1998 through 31 December 1998.

There were no significant MSFCMA law enforcement cases relating to bottomfish/ seamount groundfish fisheries that were prosecuted by the National Marine Fisheries Service or Coast Guard in 1998.

The Coast Guard continues to conduct surveillance of the Hancock Seamount area. The Coast Guard utilizes C-130 aircraft and cutters to patrol the Northwest Hawaiian Islands/Hancock Seamount.

The Coast Guard conducted over 150 hours of fisheries patrols with aircraft during 1998. Almost 75 days of surface patrols were also conducted. The Coast Guard patrol effort is broken down as follows:

Bottomfish Area	Surface Patrol Days	Aircraft Patrol Days
Main Hawaiian Islands	65	121
Northwest Hawaiian Islands	9	42

The Coast Guard has established a program under a cooperative enforcement agreement to assist the State of Hawaii with the enforcement of their Bottomfish Management Plan, enacted in June 1998. The program consists of developing liaison with local DLNR DOCARE island supervisors. Assistance is provided: 1) in the course of normal Coast Guard patrols, 2) in response to specific requests for support, 3) during scheduled cooperative patrols.

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Appendix 8. Glossary

<u>TERM</u>	<u>DEFINITION</u>
Alia	Samoaan fishing catamaran, about 30 feet long, constructed of aluminum or wood with fiberglass. Used for various fisheries including trolling, longline, and bottomfishing
AP	Advisory Panel. Appointed industry/government/educational representatives functioning in an advisory capacity to the Council.
Armorhead	Groundfish found on the SE Hancock Seamount in the Northwestern Hawaiian Islands
AS or American Samoa	Includes the islands of Tutuila, Manua, Rose and Swains Atolls.
ASDPW	Department of Public Works, American Samoa. Also, DPW.
BARB	Bottomfish Advisory Review Board
BMUS	Bottomfish Management Unit Species, include deep and shallow water bottomfish species
BPT or PT	Bottomfish Plan Team. Advisory body to the Council composed of scientists and fishermen who monitor and manage the fisheries under the jurisdiction of the Bottomfish and Seamount Groundfish FMP.
Bycatch	Fish caught in a fishery but discarded or released, except in a recreational fisheries catch and release program.
Commercial	Commercial fishing, where the catch is intended to be sold, bartered, or traded.
CNMI or Commonwealth of the Northern Mariana Islands	Also, Northern Mariana Islands, Northern Marianas, and NMI. Includes the islands of Saipan, Tinian, Rota, and many others in the Marianas Archipelago.
CPUE	Catch-Per-Unit-Effort. A standard fisheries index usually expressed as numbers of fish caught per unit of gear per unit of time, e.g. number of fish per hook per line-hour or number of fish per 1,000 hooks. The term catch rate is sometimes used when data are insufficiently detailed to calculate an accurate CPUE.
DAWR	Division of Aquatic & Wildlife Resources, Territory of Guam.
DBEDT	Department of Business, Economic Development & Tourism, State of Hawaii.
DFW	Division of Fish & Wildlife, Northern Mariana Islands.

DLNR	Department of Land & Natural Resources, State of Hawaii. Parent agency for Division of Aquatic Resources (HDAR).
DMWR	Department of Marine & Wildlife Resources, American Samoa. Also, MWR.
EEZ	Exclusive Economic Zone, refers to the sovereign waters of a nation, recognized internationally under the United Nations Convention on the Law of the Sea as extending out 200 nautical miles from shore. Within the U.S., the EEZ typically is between three and 200 nautical miles from shore.
ESA	Endangered Species Act. An Act of Congress passed in 1966 that establishes a federal program to protect species of animals whose survival is threatened by habitat destruction, overutilization, disease etc.
FAD	Fish Aggregating Device; a raft or pontoon, usually tethered, and under which, pelagic fish will concentrate.
FDCC	Fishery Data Coordinating Committee, WPRFMC.
FFA	Forum Fisheries Agency. An agency of the South Pacific Forum, which comprises the independent island states of the South Pacific, Australia and New Zealand. The FFA formed to negotiated access agreements between FFA member countries and distant water fishing nations such as Japan and the USA.
FMP	Fishery Management Plan.
GU or Guam	A U.S. territory in the Marianas Archipelago. South of and adjacent to the Commonwealth of Northern Marianas Islands.
HI or Hawaii	U.S. state. See MHI, NWHI. Composed of the islands, atolls and reefs of the Hawaiian Archipelago from Hawai'i to Kure Atoll, except Midway Islands. Capitol - Honolulu.
HDAR	Hawaii Division of Aquatic Resources. Also, DAR.
Hoomalu Zone	Bottomfish management area located in the northwestern Hawaiian Islands, includes area from French Frigate Shoals to Kure, including Hancock seamount.
Incidental Catch	Fish caught that are retained in whole or part, though not necessarily the targeted species. Examples include monchong, opah and sharks.
Interaction	Catch of protected species, which is required to be released.- Examples: Hawaiian monk seals, marine turtles and albatrosses.
Mau Zone	Bottomfish management area located north of Kauai created as a

MFCMA	Magnuson Fishery Conservation and Management Act of 1976. Also, Magnuson-Stevens Fishery Conservation and Management Act of 1996. Sustainable Fisheries Act.
MHI	Main Hawaiian Islands (comprising the islands of Hawai'i, Mau'i, Lana'i, Moloka'i, Kaho'olawe, O'ahu, Kauai', Ni'ihau and Ka'ula).
MSY	Maximum Sustainable Yield.
NMFS	National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce. Also NOAA Fisheries.
NOAA	National Oceanic and Atmospheric Administration, Department of Commerce.
NWHI	Northwestern Hawaiian Islands. All islands in the Hawaiian Archipelago, other than the Main Hawaiian Islands (MHI).
OY	Optimum Yield.
PAO	Pacific Area Office, National Marine Fisheries Service. Also, NMFS/PAO.
Protected	Refers to species which are protected by federal legislation such as the Endangered Species Act, Marine Mammal Protection Act, and Migratory Bird Treaty Act. Examples: monk seals, marine turtles, dolphins.
Recreational	Recreational fishing for sport or pleasure, where the catch is not sold, bartered or traded.
SAFE	Stock Assessment and Fishery Evaluation, NMFS.
Secretary	When capitalized and used in reference to fisheries within the U.S. EEZs, it refers to the U. S. Secretary of Commerce.
SPC	South Pacific Commission. A technical assistance organization comprising the independent states of South Pacific Ocean, dependant territories and the metropolitan countries of Australia, New Zealand, USA and France.
SPR	Spawning Potential Ratio. A term for a method to measure the effects of fishing pressure on a stock by expressing the spawning potential of the fished biomass as a percentage of the unfished virgin biomass. Stocks are deemed to be overfished when the $SPR < 20\%$.
SSC	Scientific & Statistical Committee, an advisory body to the Council comprising experts in fisheries, marine biology, oceanography, etc.
Trolling	Fishing by towing lines with lures or live-bait from a moving vessel.

USCG	U.S. Coast Guard, 14 th District, Department of Transportation.
USFWS	U.S. Fish & Wildlife Service, Department of Interior. Also, FWS.
VMS	Vessel Monitoring System. A satellite based system for locating and tracking fishing vessels. Fishing vessels carry a transponder which can be located by overhead satellites. Two-way communication is also possible via most VMS systems.
WPacFIN	Western Pacific Fishery Information Network, NMFS.
WPRFMC	Also, the Council. Western Pacific Regional Fishery Management Council. One of eight nationwide fishery management bodies created by the Magnuson Fisheries Conservation and Management Act of 1976 to develop and manage domestic fisheries in the U.S. EEZ. Composed of American Samoa, Guam, Hawaii, and Commonwealth of Northern Mariana Islands.

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